WATER & RELATED LAND RESOURCES

OF THE

CONNECTICUT RIVER REGION

MASSACHUSETTS

U.S. DEPARTMENT OF AGRICULTURE
ECONOMICS, STATISTICS & COOPERATIVES SERVICE
FOREST SERVICE
SOIL CONSERVATION SERVICE
in cooperation with
MASSACHUSETTS WATER RESOURCES COMMISSION

AUGUST 1978

PREFACE

The United States Department of Agriculture, in cooperation with the Massachusetts Water Resources Commission, is participating in a study of the water and related land resources within the Commonwealth. This report presents the results of that study in the Connecticut River Region which consists of the Chicopee, Deerfield, Farmington, Millers, Westfield, Northern Connecticut Valley, Central Connecticut Valley, and Southern Connecticut Valley Study Areas.

The report was prepared by the Soil Conservation Service; Economics, Statistics, and Cooperatives Service; and Forest Service for use by the Massachusetts Water Resources Commission in the preparation of a comprehensive plan for the Commonwealth's water and land resources. The information and data will also assist local, state, and federal agencies in their specific planning activities for the coordinated and orderly conservation, development, utilization, and management of the water and land resources of Massachusetts.

The objectives of this report are to identify problems, needs, and alternative solutions in the following major resource areas: land use, flooding, erosion, sediment, and wetlands.

Acknowledgement is made to the Conservation Districts, Regional Planning Agencies, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Geological Survey (Water Resources Division), and the Massachusetts Executive Office of Environmental Affairs for their assistance in the development of this report. Thanks is extended to the many persons who gave of their time to review the drafts and who gave valuable suggestions.

Special acknowledgement is made to the personnel of the Massachusetts Division of Water Resources who prepared the material for Appendix C and provided continuing assistance throughout the development of this report. Also, a special thanks to the College of Food and Natural Resources, University of Massachusetts at Amherst, for assistance in agricultural land mapping and use of their data on land use, natural resources, and economics.

Cover--A view of the Connecticut River Valley from Mt. Sugarloaf, South Deerfield, Massachusetts.

SCS PHOTO

MASSACHUSETTS WATER RESOURCES STUDY

CONNECTICUT RIVER REGION REPORT

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CHAPTER 1

SUMMARY

1.1 INTRODUCTION

This is a report of the study of water and related land resources of the Connecticut River Region of Massachusetts, prepared by the U.S. Department of Agriculture (USDA) and the Massachusetts Water Resources Commission. There are similar reports for the other designated regions of Massachusetts. The objectives of this study are to identify problems, determine needs through 1990, and suggest alternatives which can be used by the Massachusetts Water Resources Commission to prepare a comprehensive state water and related land resources plan. Information contained in this report will be useful to state, regional, and local agencies concerned with land use and natural resource planning.

For the purposes of the Massachusetts Water Resources study, the state was divided into four regions: Berkshire, Connecticut River, Central, and Coastal. The Charles River Basin, within the area of the Coastal Region, is not included, as studies in that area were completed in a cooperative study with the Corps of Engineers.[1/] Figure 1.1 indicates the regions.

The Connecticut River Region is an area of about 2,700 square miles which is the Connecticut River drainage within Massachusetts. The major streams are the Chicopee, Deerfield, Farmington, Millers and Westfield Rivers. The region includes 94 cities and towns within five counties. A listing of cities and towns by study area can be found in Chapter 5, Table 5.15 (Wetland Areas).

The Soil Conservation Service, Forest Service, and the Economics, Statistics, and Cooperatives Service are the United States Department of Agriculture agencies participating in this study. The Massachusetts Divisions of Water Resources, Fisheries and Wildlife, Forests and Parks, and Water Pollution Control, and the Massachusetts Department of Food and Agriculture are the state agencies most actively involved.

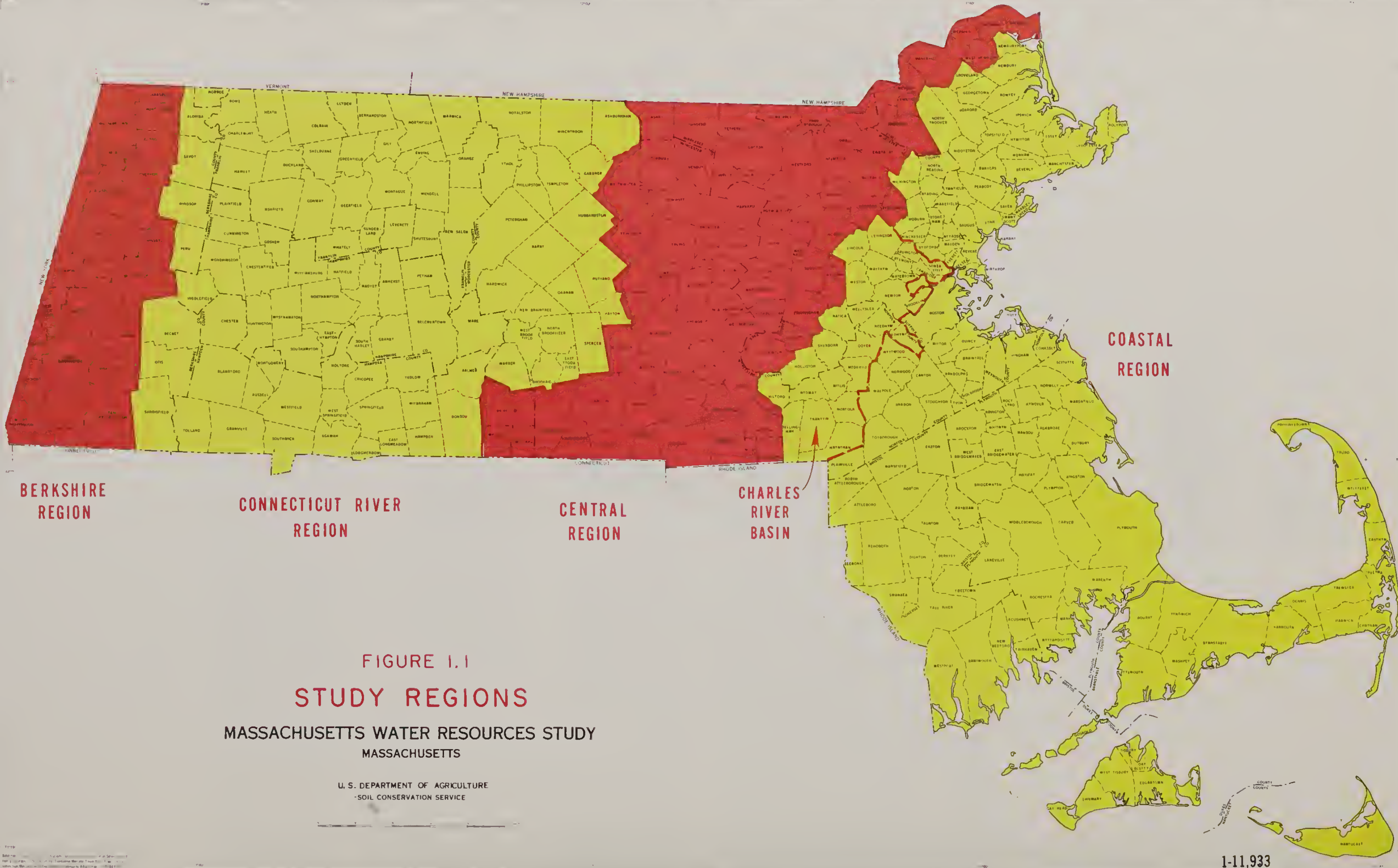

FIGURE 1.1

STUDY REGIONS

MASSACHUSETTS WATER RESOURCES STUDY

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1.2 FINDINGS OF THIS STUDY

1.2A Land Use

In 1975, population of the region was about 749,600 people. The population is expected to increase 10.2 percent to about 826,300 people by 1990.

Forest is the dominant land use in the Connecticut River Region occupying about 73 percent of the area or 1,295,301 acres. Over 7 percent of the land is urban and 10.1 percent is agricultural. Wetlands, water, and "other" land uses make up the balance.

During the 20-year period between 1952 and 1972, significant changes have occurred. Agricultural land decreased by 27 percent (66,182 acres) while urban land increased over 150 percent (75,387 acres). Three different techniques were used to project the agricultural land decrease through the year 1990. These techniques resulted in a range of 16,501 to 102,908 acres between 1974 and 1990. Projections also indicate that urban land is expected to increase by 39 percent (49,508 acres) by 1990.

The state as well as the region is experiencing a continuing decrease in the quantity of agricultural land. The loss of suitable farmland soils to other land uses is nearly irreversible. In addition to reducing the land base available for growing food, the loss of farmland results in a deterioration of the visual and aesthetic quality of the environment. Alternative measures such as, zoning, purchase of development rights, and acquisition, are suggested which, if implemented, might slow the loss of agricultural land.

The forest land resource provides wood products, water, forage, wildlife, and recreation. Most of the forested land is privately owned, much of it in small tracts. Land is owned for a variety of reasons, with only a small proportion owned for timber production. Only one-half of the region's forest land is available for wood product production. Alternatives to increase wood product production include: an increase in personnel to provide management assistance; an increase in forest program funding and forest land management incentives; develop diversified markets for low quality wood; and an increase in information and education programs to encourage forest land management by private landowners.

1.2B Flooding

Within the last 50 years many floods have occurred in the region. Major regional floods occurred in 1936, 1938, 1955, and 1968. These floods damaged residences, commercial buildings, industrial plants, farm fields, roads, and bridges.

Average annual flood damage in the region exceeds $1,800,000. A 100-year frequency flood today would cause damage in excess of $30 million. These figures do not include flood damages on the main stem of the Connecticut River.

A flood plain management program including measures such as flood plain zoning and flood insurance is being adopted by many towns in the region. These programs will minimize flood damage in future developments, but will not reduce flood damages to existing developments in flood plains. However, flood insurance can reduce the monetary risk for individuals. Seventy-three towns have joined the National Flood Insurance Program which allows property owners to purchase low cost flood insurance. In return for this federally-subsidized insurance, the towns are required to regulate future construction within flood hazard areas.

If the flood insurance program is fully implemented with the required regulatory measures, and if the present trend to establish other flood plain management measures continues, future flood plain development is expected to be greatly reduced. As a consequence, flood damage should not increase significantly.

Because of the many existing developments in flood plains, alternatives are needed to reduce flood damage to an acceptable level. The three corrective flood plain management techniques investigated in this study were floodproofing, structural measures, or a combination of floodproofing and structural measures. Investigations showed that application of these alternatives, where feasible, could reduce the average annual flood damage of the region by about one-third (excluding main stem, Connecticut River).

1.2C Erosion and Sediment

The region experiences less severe erosion and sedimentation problems than much of the rest of the United States. However, these problems cannot be discounted entirely. The annual erosion in the region is estimated to be 1,313,000 tons. About 158,000 tons of sediment are delivered to watercourses each year. Erosion on construction sites and tilled cropland is about 318,000 and 215,000 tons per year, respectively.

Enactment of ordinances for erosion and sediment control on construction sites, stabilization of critical erosion areas, and increased emphasis on the installation of land treatment measures on tilled cropland are suggested as alternatives to alleviate the erosion and sediment problems.

1.2D Wetlands

About 70,000 acres of inland wetlands in the region provide many benefits including flood control, wildlife habitat, open space, and water quality protection. The ongoing wetlands programs, especially Massachusetts' pioneer wetlands legislation, will go far in protecting wetlands from harmful alteration.

Increased public acquisition of wetlands, acceleration of the Inland Wetlands Restriction Program, and expanded conservancy zoning of wetlands are included in the alternatives.

1.2E Water Supply and Irrigation

Municipal water for the Connecticut River Region comes from both ground water and surface sources. It may be supplied by private concerns, municipalities or the Metropolitan District Commission (MDC). Appendix A of this report identifies potential reservoir sites which might fill needs for municipal water supply for individual communities or small regional systems.

Irrigation water used by agriculture represents a very small part of the total water supply and water use in the region. Water supplies for this purpose are expected to be adequate to meet 1990 needs.

1.2F Water Quality

Existing programs and regulations are potentially adequate to enable the region to meet water quality goals. Point sources of pollution have been drastically reduced in the past 5 years and additional progress is expected. Nonpoint sources of water pollution are to receive very limited attention under Section 208 of the Water Pollution Control Act Amendments of 1972, since only two towns (Rutland and Paxton) in this region are within designated areas for application of the Section 208 program.

The Connecticut, Millers and Westfield Rivers have the most serious pollution problems. However, improvement of water quality has been noted and should continue as the treatment plant construction program is implemented. Water quality improvement in the major rivers of the region is first dependent on adequate treatment of point sources of pollution.

Obtaining detailed soil surveys in communities where projected population growth indicates the need, is included as an alternative. Soils information is needed to plan residential development to minimize onsite sewage disposal problems and the resulting effects on water quality. Alternatives to alleviate sediment and erosion problems and preserve wetlands will also contribute to water quality needs.

1.2G Recreation

Projections in the Statewide Comprehensive Outdoor Recreation Plan (SCORP) indicate that an unmet demand exists now, and will exist in 1990 for swimming, camping, picnicking, and hiking. Alternatives are presented which will meet some of the needs. These include development of greenways, implementation of the Massachusetts Scenic and Recreational Rivers Act, acquisition of unique natural areas, and development of facilities for swimming, camping, and picnicking.

1.3 SUMMARY

Table 1.1 summarizes the major findings, problems, potential solutions and program opportunities determined as a result of this study.

TABLE 1.1 PROBLEMS AND OTHER FINDINGS OF THE STUDY

Resource Area	Findings/Problems	Potential Solutions and Needed Actions	Program Opportunities	
			USDA	Other
1. Land use	1. Agricultural land acreage has declined 27% from 1952 to 1972 & is projected to decline further.	Develop programs that help maintain agricultural land use.		Farm management and farm account work at U. Mass. Cooperative Extension Service.
		Identify important farmland soils.	Soil survey program.	Chap. 61 and 61A of the Mass. General Laws, Chap. 780, Acts of 1977, Chap. 232, Acts of 1977.
	2. Forest land (approximately 73% of the region) is underutilized.	Increase management of public & private land.	Resource conservation and development (RC&D) program.	Chap. 61 and 61A of Mass. Gen. Laws.
		Increase incentives to landowners.	Cooperative forest management program.	Small Business Administration.
		Develop diversified markets.	General forestry assistance program.	
		Establish an information and education program.	Harvest improvement program.	
			Forestry incentives program.	
			Sawmill improvement program.	

TABLE 1.1 - cont. PROBLEMS AND OTHER FINDINGS OF THE STUDY

Resource Area	Findings/Problems	Potential Solutions and Needed Actions	Program Opportunities	
			USDA	Other
2. Flooding	1. Future urban flood plain development is expected to be highly restricted.	Enroll towns not now in National Flood Insurance Program.	PL 83-566, Watershed protection & Flood Prevention Act, SCS.	HUD National Flood Insurance Program.
	2. Average annual flood damage to existing development exceeds $1,800,000 (excluding Connecticut River main stem).	Implement plans for structural and nonstructural measures.	RC&D Program., SCS.	Corps of Engineers' Small Watersheds and Emergency Projects. Chap. 131, Sec. 40A Inland Wetlands Restriction Act.
3. Erosion and Sediment	1. Erosion on construction sites is an important erosion problem.	Develop erosion and sediment control ordinances at the municipal level.	Conservation Operations Program, SCS.	Technical assistance from Conservation Districts with inputs from Cooperative Extension Service and Regional Planning Commissions.
	2. Erosion rates on approximately 20% of tilled cropland are unacceptably high and result in lowered agricultural productivity.	Inventory cropland with serious erosion problems. Establish priorities for technical and financial assistance to assist landowners install practices to reduce erosion losses.	Conservation Operations Program, SCS; Soil & Water Conservation Loans, FmHA; Agricultural Conservation Program, ASCS.	Technical assistance from Conservation Districts.
	3. Region has some critical erosion problem areas and eroding streambanks.	Develop measures to stabilize critical areas and problem streambanks.	RC&D Program, SCS.	

TABLE 1.1 - cont. PROBLEMS AND OTHER FINDINGS OF THE STUDY

Resource Area	Findings/Problems	Potential Solutions and Needed Actions	Program Opportunities USDA	Program Opportunities Other
4. Wetlands	1. Region has 69,600 acres of inland wetlands which should be protected from harmful alteration.	Accelerate Inland Wetlands Restrictions Program.		Inland Wetlands Restriction Act.
		Projected 6,000 acres of inland wetlands will be acquired by 1990. Acquire additional 6,000 acres by 1990.		Financial assistance for cities and towns for acquisition, state - Self-Help Fund, Gen. Laws, Ch. 132A, Sec. 11. Federal - USDI, Heritage Conservation & Recreation Service. Land and Water Conservation Fund.
		Expand conservancy zoning to include majority of the region's wetlands.	Mass. Natural Resources Technical Team.	Technical assistance from Conservation Districts.
5. Water Supply and Irrigation	1. Additional municipal water supply will be needed by 1990.	Additional water supply can be developed from groundwater and/or surface water sources. Potential surface water reservoirs indicated in Appendix A.	USDA Farmers Home Administration loans for community water supply systems.	HUD loans and financial assistance for municipal water supply.
	2. Little irrigation water use, except for truck crops and shade tobacco. Existing programs are adequate.			

TABLE 1.1 PROBLEMS AND OTHER FINDINGS OF THE STUDY

Resource Area	Findings/Problems	Potential Solutions and Needed Actions	Program Opportunities	
			USDA	Other
6. Water Quality	1. "Section 208" water quality studies for designated areas are underway in only two towns in the region.			
	2. Detailed Soil survey information is not available for entire region.	Provide detailed soil survey.	Special soil surveys and interpretation prepared for towns by SCS.	
	3. Sediment from land and streambank erosion.	Same potential solutions, needed actions, and program opportunities as listed under Erosion and Sediment (Resource Area 3).		
7. Recreation	1. There are insufficient swimming, camping, picnicking, and hiking facilities.	Provide additional swimming, camping, picnicking, and hiking facilities.		USDI, Heritage Conservation & Recreation Service, Land & Water Conservation Fund. Mass. - Self-Help Fund, Gen. Laws, Ch. 132A, Sec. 11. Mass. - Public Access Fund, Gen. Laws, Ch. 21, Sec. 17.
	2. Region has numerous unique natural features.	Plan for preservation of scenic rivers and unique natural areas.	Renewable Resources Program. USDA - Forest Service and Mass. Div. of Forests and Parks.	Nature Conservancy Program.

NOTES

1/ Water Resources Development Plan, Charles River Watershed, Massachusetts, U.S. Army Corps of Engineers, Waltham, Massachusetts, April 1972, and Charles Study Area, U.S. Department of Agriculture, Amherst, Massachusetts, May 1972.

CHAPTER 2

INTRODUCTION

2.1 GENERAL

The Massachusetts Water Resources Study was initiated by a cooperative agreement between the U.S. Department of Agriculture (USDA) and the Massachusetts Water Resources Commission (MWRC). This water and related land resources study provides data to the Commission for use in the preparation of an overall State Water and Related Land Resources Plan.

2.2 AUTHORITY FOR USDA AND OTHERS' PARTICIPATION

The USDA participated in this study at the request of the MWRC. Section 6 of the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended) authorizes such participation by USDA. The Forest Service, Economics, Statistics, and Cooperatives Service, and the Soil Conservation Service are the USDA agencies participating in this study.

The MWRC has the responsibility under state law to develop an overall plan and to coordinate federal, state, and other agencies in the water resources field.

The Massachusetts Divisions of Water Resources, Forests and Parks, Fisheries and Wildlife, and Water Pollution Control, and the Massachusetts Department of Food and Agriculture are the state agencies most actively involved in this study.

2.3 OBJECTIVES AND NATURE OF STUDY

Water and related land resource planning by federal agencies is guided by the Principles and Standards (P&S) established by the U.S. Water Resources Council.[1/] The Principles and Standards established a thorough and organized approach to water and related land resource planning for two broad national objectives:

1. National Economic Development (NED)--to enhance national economic development by increasing the value of the nation's output of goods and services and improving national economic efficiency.

2. Environmental Quality (EQ)--to enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

Specific objectives are listed in Chapter 3, Problems and Objectives.

2.4 PLANNING PROCEDURES AND REPORT PRESENTATION

The planning process, established by the P&S, is designed to produce a recommended plan. The Massachusetts Water Resources Study planning process differs in that the process stops with the development of alternatives. The selection of a final or recommended plan is the responsiblity of the Massachusetts Water Resources Commission.

This study investigated the following resource areas in detail: Land Use, Flooding, Erosion and Sediment, and Wetlands. The resource areas of Water Quality, Water Supply and Irrigation, Drainage, Fish and Wildlife, and Recreation are ordinarily subjects of investigation for a Cooperative Water Resources Study. However, these resource areas have been, or are being studied in detail by others. To avoid duplication of effort and to allow more time and effort to be expended upon the four areas studied in detail, it was decided to only briefly investigate the other areas. In some cases, the data and conclusions from previous studies are reported to maintain continuity. In other instances, it was found that new resource data could be generated in a specific phase of a resource area.

The principles which guided study intensity were:

1. Areas that were adequately covered by previous studies would not be restudied, and

2. only resource areas where the expertise of USDA agencies was recognized would be studied in detail.

The Massachusetts Water Resources Study planning process approximates the first four steps of the P&S process which are as follows:

1. Specify components of the objectives relevant to the planning setting.

2. Evaluate resource capabilities and expected conditions without any plan.

3. Formulate alternative plans to achieve varying levels of contributions to the specified components of the objectives.

4. Analyze the differences among alternative plans which reflect different emphasis among the specified components of the objectives.

In addition, the P&S requires that beneficial and adverse effects of alternatives or plans on National Economic Development and Environmental Quality be displayed. P&S also suggests that beneficial and adverse effects of alternatives be displayed, where appropriate, for Regional Development and Social Well-Being.

Study results are presented in chapters which reflect the P&S suggested planning process. Data findings in each resource area are placed in the appropriate planning chapter, so that the report enables the reader to follow the step-by-step procedures used to develop the alternatives. The major chapter format is, as follows:

Chapter 1 (Summary) ---- A brief introduction and summary of the findings.

Chapter 2 (Introduction) ---- Outlines the purpose, authority and objectives along with a general description of the study area. It also acknowledges the assistance and cooperation of others.

Chapter 3 (Problems and Objectives) ---- The resource problems are stated in terms of their effect on the two main objectives: National Economic Development and Environmental Quality. Specific components of the two main objectives are presented.

Chapter 4 (Economic Projections and Environmental Considerations) ---- Projections of social, economic, and natural resources base data are presented, including projections of population, employment, income, urban development, agricultural and forest activity, and other significant social and economic categories. The relationship between the projections and specific components of the National Economic Development objectives are presented. Projections concerning the environmental setting are also contained in this chapter. Effects of population distribution and land use changes on the environment are discussed.

Chapter 5 (Resource Base and Existing Programs) ---- The existing situation is presented in this chapter. Physical data, such as location, size, soils, geology, vegetative cover, climate, and land use are included. Existing conditions in the four major resource areas (flooding, erosion and sediment, wetlands, and land use) are covered in detail. Existing USDA and other programs which are being utilized to meet resource needs are explained.

Chapter 6 (Future-Without-Plan Condition) ---- This chapter describes the conditions to be expected in each of the resource areas if no new alternatives are planned and implemented. The effects of presently authorized projects are considered along with the effects of nonaction.

Chapter 7 (Needs) ---- Needs are defined as the difference between conditions expressed in the Economic Projections and Environmental Considerations section and those adequately addressed by ongoing and planned projects described in the Future-Without-Plan Condition Chapter. This chapter quantifies the extent of the problems outlined in the Problems and Objectives Chapter.

Chapter 8 (Alternatives) ---- This chapter presents a number of alternatives designed to fill the needs expressed in the preceding chapter. Displays showing effects of the alternatives on the four P&S accounts (National Economic Development, Environmental Quality, Regional Development, and Social Well-Being) are included. In addition, alternatives are contrasted with their potential effects on about 20 major environmental indicators.

Chapter 9 (Program Implementation of Alternatives) ---- The chapter describes how USDA programs can be used to implement the alternatives expressed in Chapter 8. Opportunities for other state or federal programs are also discussed. If no existing programs are available to implement an alternative, the need for new or revised programs is investigated.

2.5 GENERAL DESCRIPTION OF THE STUDY AREA

For the Massachusetts Water Resources Studies, Massachusetts was divided into four regions: Berkshire, Connecticut River, Central, and the Coastal. Reports have been completed on the Berkshire Region and on the Charles River in the Coastal Region.

The Connecticut River Region includes all of the drainage area of the Connecticut River within Massachusetts. This region is bounded by the Connecticut border on the south, the New Hampshire and Vermont borders on the north, the Berkshire Region on the west, and the Central Region on the east.

The region includes all of Franklin and Hampshire Counties and portions of Berkshire, Hampden and Worcester Counties. The region is composed of 94 towns or cities and eight study areas which are defined on a watershed boundary basis. The eight study areas are the Chicopee, Deerfield, Millers, Westfield, Farmington; and the Northern, Central and Southern Connecticut Valley (see Figure 2.1).

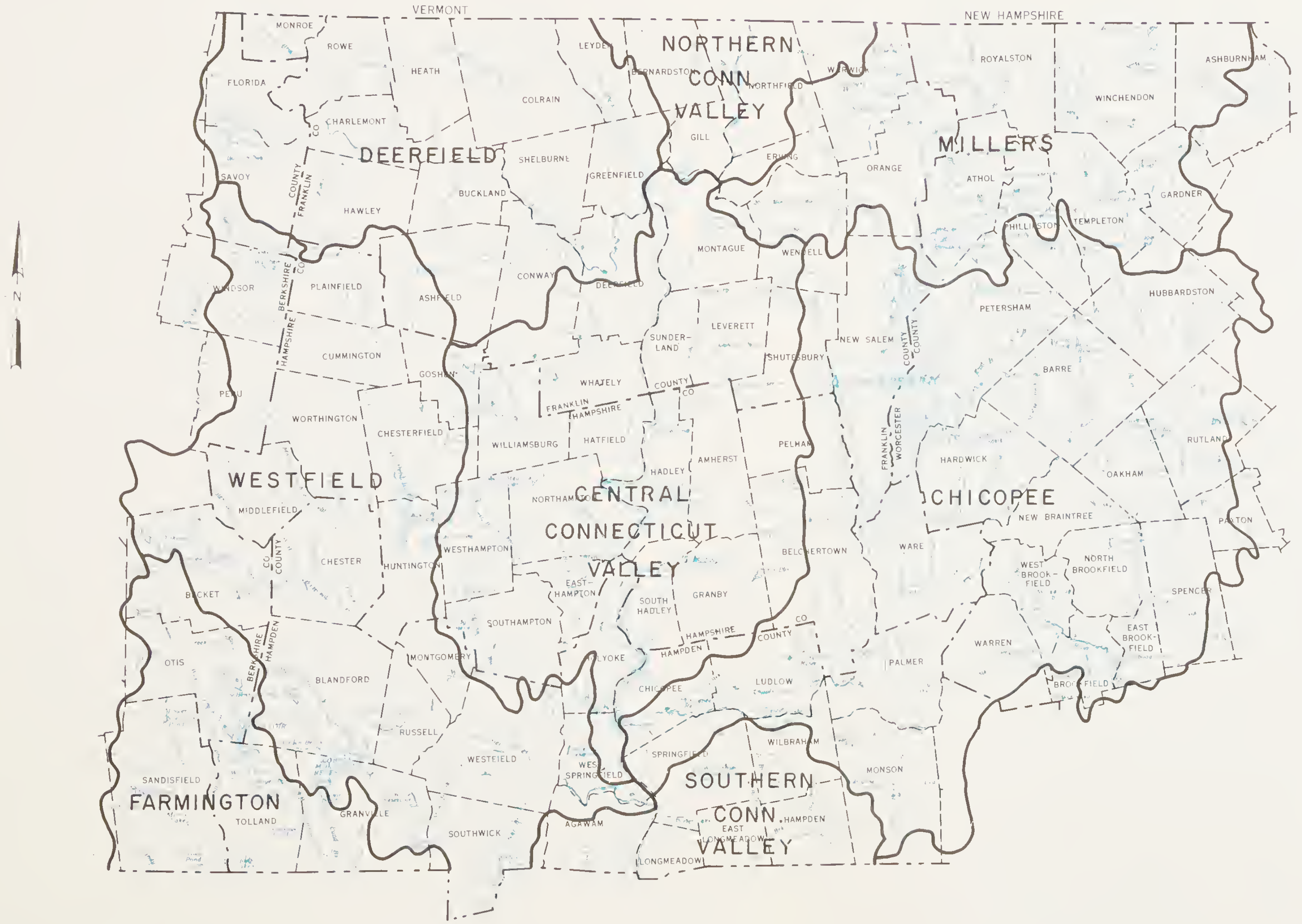

FIGURE 2.1

TOWNS AND STUDY AREAS

CONNECTICUT RIVER REGION
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The one complete Standard Metropolitan Statistical Area (SMSA) within the region is the Springfield-Chicopee-Holyoke complex. A portion of the Worcester-Fitchburg-Leominster SMSA is also within the region.

Where applicable, data and findings will be presented for each study area, and occasionally for county areas within the region and SMSAs. In those cases where no improvement will be made, presentations will be for the entire Connecticut River Region.

2.6 POPULATION

The 1975 total permanent population of the Connecticut River Region was 749,646, an increase of 18,645 (2.6 percent) since 1970 and an increase of 80,247 (12 percent) since 1960. Table 2.1 summarizes the permanent population trends for each of the county areas within the Connecticut River Region.

TABLE 2.1 POPULATION AND POPULATION CHANGES, 1950-1975

	County					Total
Year	Berkshire	Franklin	Hampshire	Hampden	Worcester	Connecticut Region
1950	2,836	52,747	87,594	365,915	77,674	586,766
1960	3,206	54,924	103,229	426,719	81,321	669,399
1970	4,014	59,210	123,981	455,360	88,436	731,001
1975	4,915	63,420	134,276	456,028	91,007	749,646
Change 1950/75	2,079	10,673	46,682	90,113	13,333	162,880
% Change 1950/75	73.3	20.2	53.3	24.6	17.2	27.8
Change 1960/75	1,709	8,496	31,047	29,309	9,686	80,247
% Change 1960/75	53.3	15.5	30.1	6.9	11.9	12.0
Change 1970/75	901	4,210	10,295	668	2,571	18,645
% Change 1970/75	22.5	7.1	8.3	0.2	2.9	2.6

Source: Massachusetts Department of Commerce and Development, Town Monographs, the Regional Planning Commissions, and the U.S. Census.

2.7 ECONOMIC ACTIVITY

Most of the towns and cities in the Connecticut River Region were established during the late 1600s and early 1700s with a few towns being established in the early 1800s. Initially, the economic activity in the region centered around a nearly self-sufficient subsistence form of

agriculture. As population and settlement grew, demands for production rose. As agricultural production increased to meet the increased demand, newer technologies were adopted, and labor that was formerly employed in agriculture was freed to work in nonagricultural activities and thus became more specialized. Typical enterprises included sawmills and grist mills; brick-making factories; cotton and wool mills; paper; tanneries; and boot and shoe factories. Most of the early towns or cities were established on the Connecticut River and its major tributaries primarily because such rivers supplied inexpensive water power utilized in the various economic activities. With the advent of steam in the late 1800s, canals and water transportation were replaced by railroads. Towns were affected either positively or adversely, depending upon the railroad route.

The Connecticut Region is heavily influenced by the Springfield-Chicopee-Holyoke SMSA. In 1950, the per capita income in this SMSA was higher than the state average of $2256. Since that time, however, this SMSAs per capita income has consistently been lower than the Massachusetts average, amounting to between 89 and 93 percent of the state average. The economy has been relatively stable throughout that period. In the 12 years between 1950 and 1962, total earnings increased from $888,628 to $1,181,299 (an increase of $292,671). Between 1962 and 1969, total earnings increased $324,066 but fell by $5,355 between 1969 and 1970. This trend was reversed in the following year where total earnings increased $9,404. (Figures in this paragraph are 1967 dollars.)

Manufacturing is presently the largest employer, followed by the wholesale and retail trade and the service sector. Relative to the rest of the state, the Connecticut Region has been faring poorly. The Berkshire Region, the Coastal Region, and the Central Region all have per capita incomes that are above the state average. Although total earnings have increased since 1950 in terms of constant dollars, the rate of increase suggests that the Springfield-Chicopee-Holyoke SMSA is in somewhat of a lethargic condition. Table 2.2 summarizes the various employments and percentages by sector.

TABLE 2.2

EMPLOYMENT BY COUNTY AREA, 1974

	Berkshire 1/	Franklin	Hampshire	Hampden	Worcester	Total	Percent Total 2/	Percent State 4/	Percent National 5/
Agriculture & Mining 3/	6	121	186	552	70	935	0.4	.7	4.8
Construction	711	734	1,308	6,336	690	9,779	4.5	4.3	6.3
Manufacturing	12	5,774	8,061	57,971	13,161	84,979	39.5	33.8	27.1
Transportation, Communications & Utilities	18	913	765	7,687	647	10,030	4.7	6.0	7.0
Wholesale & Retail Trade	30	3,760	7,370	40,797	4,076	56,033	26.1	26.2	21.3
Finance, Insurance & Real Estate	21	512	963	9,940	699	12,135	5.6	7.0	5.2
Service Industrial	309	3,018	6,812	27,840	3,190	41,169	19.1	22.0	28.0
Total	1,107	14,832	25,465	151,123	22,533	215,060	99.9	100.0	99.7
1975 Population	4,915	63,420	134,276	456,028	91,007	749,646			
Ratio-Employment/ Total Population	.225	.234	.190	.331	.248	.287		.319	.360

1/ Employment listed for Berkshire County incomplete in that information from towns with less than three firms are not divulged because of state disclosure laws.

2/ Individual entries may not sum to one due to rounding.

3/ Total employment underestimated since only those firms reporting to the Office of Massachusetts Employment Security are included.

4/ Computed from County Business Patterns 1971/72, Massachusetts, U.S. Department of Commerce, Bureau of the Census.

5/ Computed from 1972 OBERS, Series E. Report, Volume 4, U.S. Water Resources Council.

Source: City and Town Monographs, Massachusetts Department of Commerce and Development, Revised 1975.

NOTES

1/ Water Resources Council, Water and Related Resources, Establishment of Principles and Standards for Planning, Federal Register, Vol. 38, No. 174, Part III, September 10, 1973.

CHAPTER 3

PROBLEMS and OBJECTIVES

3.1 INTRODUCTION - PRINCIPLES AND STANDARDS

According to the U.S. Water Resources Council's Principles and Standards for Planning Water and Related Land Resources, the overall purpose of water and land resource planning is to promote the quality of life by reflecting society's preferences for attainment of two major objectives:

1. The enhancement of National Economic Development (NED) by increasing the value of the nation's output of goods and services, and improving national economic efficiency.

2. The enhancement of the Environmental Quality (EQ) by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

The NED objective is attained by measures and actions which result in an increase in the value of goods and services and which improve national economic efficiency. An important component of the NED objective is the value of increased output of goods and services resulting from an action. Water resource alternatives can result in increased production of goods and services which can be measured in terms of increased crop yields, increased recreational use, and reduced flood damages. Increased production from the employment of otherwise unemployed or underemployed resources may also result.

The EQ objective reflects concern for the natural environment and its maintenance and enhancement as a source of enjoyment and a heritage for future generations. Emphasis is given to diverting a portion of the available resources from economic development to achieve environmental goals. As our standard of living increases, there is less willingness on the part of society to accept environmental damage in exchange for economic gain. Specific components of the EQ objective include:

1. Creation or improvement of areas of natural beauty and human enjoyment such as open space, wild and scenic rivers, lakes, beaches, and wild areas;

2. management or enhancement of valuable archeological, historical, biological, and geological resources;

3. enhancement of the quality of water, land, and air resources by control and prevention of pollution, erosion, and misuse; and

4. caution in meeting development objectives in order to minimize undesirable and possible irreversible changes in the natural environment.

In each of the major water resource areas of concern, problems can be related to one or both of the major national objectives. Flood damages are a good example of a problem which fits into the category of a National Economic Development problem; i.e., flood damage results in a decrease in the value of goods and services which are produced in an area. The problem of regional wetlands loss might logically be classed as both a NED and EQ problem. Loss of wetlands results in loss of wildlife habitat (an EQ loss), as well as decreasing floodwater storage and consequently increasing flood damage downstream (an NED problem).

3.2 PROBLEMS AND OBJECTIVES

Table 3.1 presents problems or concerns for each specific resource area or study concern. Objectives related to problems are presented on two major levels: desires and preferences. The first level (desires) directly relates to the objectives as to kinds of environmental conditions or actual outputs of goods and services desired. The second level (preferences) are components of the first level, expressed in terms of specific needs appropriate to the planning setting.

TABLE 3.1

PROBLEMS AND OBJECTIVES

Resource Area	Problems (Concerns)	Objectives: 1st Level (Desires)	Objectives: 2nd Level (Preferences)
Land Use - Agricultural Land	EQ - Loss of open land.	Preserve open land.	Maintain a viable agricultural sector in order to preserve agricultural land and, thereby, preserve an aesthetically pleasing land use mix.
	NED - Loss of agricultural land to nonagricultural uses, thus decreasing agricultural production.	Preserve agricultural land to maintain or increase agricultural output.	Increase net returns to agricultural sector. Determine and minimize the factors that adversely impact upon the agricultural sector.
Land Use - Forest land	EQ - Lack of forest management in urban areas is resulting in a lessening of environmental quality.	Preserve, maintain, and enhance the quality of the environment and the ecological system.	Provide information and education programs on urban forestry. Provide additional technical assistance for management and use of urban forest resources in the region.
	NED - Underutilization of forest land resources for the production of wood products.	Increased outputs of wood products.	Increase management opportunities for forest landowners. Provide forest land management incentives. Increase market opportunities for wood products. Establish and increase information and education programs on forest management.
Inland Flooding	NED - Periodic flooding causes damage to existing residential, commercial, industrial, and public property.	Reduction of flood damage to existing damageable property.	Reduction of flood flows. Reduction of susceptibility to flooding.
	NED - Development of flood prone areas increases the damages to be expected from future floods.	Improved economic efficiency from development of flood-free areas.	Guide development away from flood prone areas.
	NED - Loss of wetland flood storage increases flood peaks and flood damage.	Avoid increased flood peaks and resulting damage.	Protection of wetland flood storage from loss by filling.

TABLE 3.1 - cont.

PROBLEMS AND OBJECTIVES

Resource Area	Problems (Concerns)	Objectives: 1st Level (Desires)	Objectives: 2nd Level (Preferences)
Erosion and Sediment	EQ - Materials eroded from unstable areas are resulting in pollution and sedimentation of water bodies and decreased visual quality.	Enhance water quality. Enhance visual quality.	Install erosion and sediment control measures. Install erosion and sediment control measures.
	NED - Erosion on cropland results in reduced agricultural productivity.	Maintain agricultural productivity.	Reduce erosion losses on those croplands with (about 20%) unacceptable erosion rates.
Wetlands	EQ - Loss or harmful alteration of inland wetlands results in decreased wildlife habitat and visual quality.	Protection of the environmental base.	Protection of wetlands from unwise development.
	NED - Loss of wetland flood storage increases downstream flood peaks and flood damage.	Avoid increased flood peaks and resulting damage.	Protection of wetland flood storage from loss by filling.
	NED - Development of wetlands increases flood damage in the developed wetlands.	Reduce future flood damage.	Protect wetland flood prone areas from development.
	NED - Lack of public access to wetlands is resulting in underutilization of a recreation resource.	Increase wetland recreation opportunities.	Secure public access to wetlands.

TABLE 3.1 - cont.

PROBLEMS AND OBJECTIVES

Resource Area	Problems (Concerns)	Objectives: 1st Level (Desires)	Objectives: 2nd Level (Preferences)
Water Supply	NED - Existing municipal water supplies will be insufficient to meet 1990 needs.	Increase available municipal water supply yield.	Develop new municipal water sources. Improve existing municipal sources and delivery systems.
Water Quality	EQ - Pollution from point and nonpoint sources is degrading water quality.	Improve water quality.	Identify pollution sources and develop abatement measures.
Recreation	EQ - Unique natural, historic, and cultural resources will be lost unless protected.	Management and protection of areas of natural beauty and human enjoyment.	Protect and manage unique natural, historic, and cultural resources.
	NED - Lack of public access to outdoor recreation resources.	Increase recreational opportunities.	Secure access to recreation areas.
	NED - Demand for outdoor recreation exceeds available supply.	Increase recreational opportunities.	Develop water-based recreational resources.

SCS PHOTO

The Rev. Jonathan Ashley House, first occupied in the 1730s, in Old Deerfield.

SCS PHOTO

Memorial Bridge on the Connecticut River with the Springfield skyline in the background.

CHAPTER 4

ECONOMIC PROJECTIONS
and
ENVIRONMENTAL CONSIDERATIONS

4.1 HISTORICAL DEVELOPMENT - GENERAL ECONOMIC DEVELOPMENT AND SIGNIFICANT EFFECTS ON THE ENVIRONMENT

During initial settlements which occurred between the early 1600s and the mid-1700s (some towns were established in the 1800s, with East Brookfield being established in 1920) the principal activity was a subsistence form of agriculture. As populations increased, flowing water was harnessed to power saw and grist mills to serve the supportive needs of the residents. Commencing during the early 1800s, manufacturing enterprises began to produce more sophisticated material goods (durable and nondurable). Factories produced large quantities of cotton and woolen goods. Button and firearm manufacturing also began at this time. Shoes, blankets, wooden products (chairs, barrels, kegs, doors and blinds), lumber, hides, and metal products were typical of the goods produced. During this period, agriculture played an important role because Massachusetts had to depend upon its own produce as well as that of nearby areas for its food supply.

As populations expanded in the Springfield, Chicopee, Holyoke, Northampton areas, demand for food and primary manufactured goods increased. As new technologies were developed, agricultural production per operator increased freeing labor which was able to pursue nonagricultural careers. After 1900, an economic structural change began to occur as the Southern states increased the manufacturing of those goods produced in Massachusetts. For example, a great number of cotton, woolen and knitting mills, and clothing manufacturing centers were relocated to the more competitive South between 1920 and the depression of the 30s. The manufacturing decline was brought about for a number of reasons: mode of transportation shifts; the introduction and expansion of the railroad; and the introduction of nonwater generated power systems, initially steam and subsequently electricity. Although manufacturing has declined, it still dominates the economic activities in the region.

The lands bordering the Connecticut River, especially those in Hampshire and Hampden Counties, are rich agricultural areas. These areas possess nearly level and fertile alluvial soils, relatively long growing seasons, and strong community and family agricultural traditions. Since 1910,

agriculture has been declining, not only in the Connecticut River Region, but throughout the whole state. Today, agricultural, forestry, fishing and mining enterprises in the region are relatively insignificant from an economic viewpoint. But from a resource planning perspective, the fact that 80 percent of the land area is in agricultural and forestry uses makes these two sectors extremely significant. To the extent that the land use mix is associated with water and related land resource management, as well as visual and environmental quality, agricultural and forest land must be a prime consideration in resource planning.

Historically, the quality of the environment has been tied very closely to the extent and type of economic activity being carried on in the region. In the Colonial period through most of the 1800s, little concern was given to the by-products of production and consumption. Air and water were both considered free goods with no cost attached to their use. As population and manufacturing increased, the increasing amounts of generated waste by-products became too concentrated to be assimilated into the environment. Consequently, air and water quality decreased and the health and well-being of the people were threatened. Thus, the cleaning of these resources became a concern which resulted in controls being imposed upon producers and consumers. Today, while there are problems that remain, the air and water quality of the region has been steadily improving.

4.2 SOCIO-ECONOMIC DATA

4.2A Population - Current and Projected

In 1950, the region's population was 586,766.[1/] By 1960, the population had grown to 669,399 for an increase of 82,633 (14.1 percent). Between 1960 and 1970 there was an increase of 61,602 people (9.2 percent). During the 5-year span between 1970 and 1975 there was an increase of 18,645 (2.55 percent). Extrapolating this 5-year span to a 10-year increment, assuming similar growth rates, translates to a 5.1 percent growth every 10 years. If it is assumed that this decreasing rate in population growth will continue, potential demands upon the available water and related land resources can be satisfied. Population and population changes between 1950 and 1975 were summarized in Table 2.1.

4.2B Employment

Employment data for the Connecticut River Region were collected from OBERS[2/] data and Town Monographs published by the Massachusetts Department of Commerce and Development. In 1950, the manufacturing sector was the dominant economic force in the region, and contributed nearly 44 percent of total earnings. Although this share has decreased since then (39 percent in 1960 and 34 percent in 1970), manufacturing still thoroughly dominates.

Wholesale and retail trade in 1950 was the next most dominant sector; but by 1970 the government and service industry had moved into second and third place respectively. Agriculture, forestry, fishing and mining are relatively insignificant and contribute less than 1 percent to total earnings. Table 4.1, Employment Earnings in Percent by Standard Industrial Classifications (SIC), summarizes the economic activity in the Connecticut River Region for the 20-year period between 1950 and 1970.

TABLE 4.1 EMPLOYMENT EARNINGS IN PERCENT BY SIC, 1950-1970

	1950	1960	1970
Agriculture, Forestry, Fishing, Mining	2.4	1.1	0.9
Manufacturing	44.0	39.0	33.6
Construction	4.7	4.4	6.1
Transportation, Utilities, Communications	5.8	5.2	5.0
Wholesale, Retail Trade	15.7	15.1	15.0
Finance, Insurance, Real Estate	4.0	5.1	5.1
Service	9.6	12.5	16.0
Government	13.5	17.4	17.8

Source: 1972 OBERS, Series E, Vol. V, p. 228.

4.2C Income

Since 1950 the Connecticut River Region has had a per capita income that has consistently been below the state average. In 1974, the average per capita income in the country was $4,242 and was $4,955 in Massachusetts. The region in that year averaged $4,308.[3/] Expected increases in leisure time and disposable income will result in increased demands on water and related land resources for recreational use.

4.2D Urban Centers and Their Influences

The Springfield-Chicopee-Holyoke SMSA is clearly the dominant urban area in terms of employment and earnings. This is true even though portions of the region are more heavily influenced by the Worcester SMSA.

4.2E Transportation

The region has an efficient road network. Interstate 91 runs north and south from Connecticut into Vermont. East-west corridors include Route 2 in the northern, Route 9 in the central, and the Massachusetts Turnpike in the southern portion of the region. State and local roads interconnect the various towns and compliment the major highway system. The major airport serving the region is Bradley Field in Windsor Locks, Connecticut.

In terms of railroad service, the Springfield-Northampton corridor is well supplied. However, the northern and the east-west portions of the area have minimum railroad access.

4.3 AGRICULTURAL RESOURCES AND RELATED ECONOMIC ACTIVITY

4.3A Major Crop and Livestock Enterprises

The Connecticut River Region is the location of more than 40 percent of all the agricultural land in the state and in 1974 contributed 34 percent of the total value of agricultural production in the state. Crops contributed 37.6 percent to the value of the region's production, livestock 53.3 percent, nursery and greenhouse operations 8.6 percent, and forest products 0.5 percent.

Table 4.2 summarizes agricultural data for three categories of farms: all farms, those with sales greater than $2,500, and those farms with less than $2,500.

Agricultural Census data for Worcester and Berkshire Counties were disaggregated to reflect that portion of the county located in the region. Since Franklin and Hampshire Counties, and all but two towns of Hampden County are totally in the region, no disaggregation was necessary for these three counties. It is interesting to note that nearly 98.8 percent of all agriculture production results from only 70.2 percent of the total number of farms--those having sales of $2,500 or more.

4.3B Employment and Income

As mentioned in section 4.1, in comparison with the total Massachusetts economy, the state's agricultural sector is relatively small, with gross cash receipts of approximately $202 million in 1974. The agricultural receipts in the Connecticut River Region contributed approximately 30 percent to the state total or $61,256,000. Taking the total cash receipts for all farms and subtracting production expenses of $51,961,000 results in a net income of $9,295,000 and an average farm net income of $5,909. When only those farms with sales over $2,500 are examined, the result is an average net income of $8,658, nearly 47 percent higher than the all farm average (see Table 4.2).

TABLE 4.2 VALUE AND COSTS OF AGRICULTURAL PRODUCTION, 1974

	Berkshire	Franklin	Hampshire	Hampden	Worcester	Total Region
	(1000 1974 $)					
Value of Ag Production						
All farms	821	15,125	18,220	13,595	13,495	61,256
Farms with sales over $2500	809	15,007	17,955	13,510	13,235	60,516
Farms with sales less than $2500	12	118	265	85	260	740
Value of Crop Production						
All farms	86	6,264	6,674	7,280	2,754	23,058
Farms with sales over $2500	81	6,201	6,502	7,237	2,687	22,708
Farms with sales less than $2500	5	63	172	43	67	350
Value of Forestry Production						
All farms	10	168	58	50	43	329
Farms with sales over $2500	10	163	50	42	39	304
Farms with sales less 'than $2500	0	5	8	8	4	25
Value of Nursery and Greenhouse Products						
All farms	38	322	2,226	1,771	885	5,242
Farms with sales over $2500	38	319	2,217	1,762	879	5,215
Farms with sales less than $2500	0	3	9	9	6	27
Value of Livestock and Livestock Products						
All farms	686	8,372	9,263	4,495	9,812	32,628
Farms with sales over $2500	680	8,325	9,186	4,465	9,631	32,287
Farms with sales less than $2500	6	47	77	30	181	341
Production Expenses						
All farms	732	12,822	15,715	11,167	11,525	51,961
Farms with sales over $2500	714	12,599	15,377	11,049	11,219	50,958
Farms with sales less than $2500	18	223	338	118	306	1,003
Net Receipts						
All farms	89	2,303	2,505	2,428	1,970	9,295
Farms with sales over $2500	95	2,408	2,578	2,461	2,016	9,558
Farms with sales less than $2500	-6	-105	-73	-33	-46	-263
Average Net/Farm						
All farms	3,708	5,700	5,081	7,807	5,777	5,909
Farms with sales over $2500	6,333	8,509	7,251	10,169	8,365	8,658
Farms with sales less than $2500	-667	-868	-429	-478	-460	-561
Number of Acres	Number					
All farms	5,712	72,909	64,891	42,123	54,705	240,340
Farms with sales over $2500	4,500	62,024	51,051	35,815	43,665	197,055
Farms with sales less than $2500	1,212	10,885	13,840	6,308	11,040	43,285
Number of Farms	Acres					
All farms	24	404	493	311	341	1,573
Farms with sales over $2500	15	283	323	242	241	1,104
Farms with sales less than $2500	9	121	170	69	100	469
Average Size of Farms	Acres					
All farms	238	180	131	135	160	153
Farms with sales over $2500	300	219	158	148	181	178
Farms with sales less than $2500	135	90	81	91	110	92

Source: 1974 Census of Agriculture.

In compiling employment data in the agricultural sector, it should be noted that certain problems exist. Most employment data in the state are generated through the Massachusetts State Division of Employment Security. The major problem is that these organizations collect data for employment covered under the statutes which charter them. Although their work has expanded in recent years, their historical data series includes only employment covered by employment compensation acts which amounts to approximately 80 percent of total employment.

4.3C Economic Factors Affecting Agriculture

One of the most obvious signs of poor economic performance of agricultural enterprises is that between 1969 and 1974, land in farms declined by nearly 99,000 acres (from 700,578 to 601,734 acres), or 14.1 percent.[4/] The most logical explanation for this decline is that individual farmers simply could not afford to stay in production given the alternative sources of income and/or employment.

Probably the most significant factor which has contributed to the decline of agriculture in the state and in the Connecticut River Region, is farm profitability. As was noted earlier, in 1974, 99 percent of the agricultural receipts were accrued by only 70 percent of the farms (that category of farm with over $2,500 in annual sales) in the Connecticut River Region. Thus, there were 469 farms with sales of under $2,500 a year. When sales income and expenses are combined, those 469 farms had an average 1974 loss of nearly $561. From this vantage point alone, it would seem reasonable that these farms on 43,285 acres may be going out of production.[5/]

Many factors impact upon profitability in the agricultural sector: rising labor and capital equipment cost; shortages of labor; alternative employment with greater pay and shorter hours; taxation; lack of a market output infrastructure (e.g., slaughtering houses, processing plants); nuisance laws; higher transportation rates than in competing regions; climate; and land. The Governor and the Commissioner of Food and Agriculture, in viewing the historical decline of the state's agricultural sector, issued a report entitled A Policy for Food and Agriculture in Massachusetts, wherein a policy to preserve agricultural land was set forth. The trend, from an agricultural perspective, is rather alarming: a decrease from 35,000 farms to a little more than 6,000 since World War II. During the same period, farmland decreased from over two million acres to a little more than 700,000.

In trying to reverse the downward trend in agriculture, two development rights bills have been passed by the Massachusetts legislature.[6/] The first bill enables city and town governments to purchase the development rights to farmland, thus precluding development on such land. The second bill provides state financing for this purpose. One rationale behind the program is that the income that a farmer would receive from

selling development rights to cropland could then be reinvested in capital improvements, thus making the operation more efficient and less costly per unit of output. Although land is just one productive input to a farming operation, such a program is a first step. In addition, this program could make available a pool of low priced land with preservation restrictions. Having such land available would be an advantage to ongoing agricultural enterprises.

Another factor in the decline of agricultural land is the manner in which land resources are allocated to development. Most of the local zoning bylaws zone agricultural land as low density development; at best, an inefficient use of a scarce resource. What is necessary is an educational effort assisting local zoning authorities to set more flexible bylaws which would relieve the pressures of development on agricultural land. Without such changes, there will be no incentive not to develop farmland, and therefore, the probability of an effective program is lessened.

As of 1976, Massachusetts was importing 85 percent of its total food consumption. In terms of specific food commodities, the state imported 97 percent of its meat, 70 percent of its eggs, 80 percent of its milk and 90 percent of its potatoes.[7/] It should be noted, however, that there are some foods that simply cannot be grown in Massachusetts because of length of growing season, soils and temperature. Such foods include citrus fruits, tropical fruits, sweet potatoes, rice, etc. and make up approximately 15 percent of the total food imports. Another 10 percent of the food imports are in the form of fresh fruits and vegetables imported during those seasons when production is not possible in Massachusetts. These products include melons, celery, lettuce, peppers, berries, etc. Physically then, Massachusetts could potentially produce 75 percent of its total food requirements, whereas today the state is only producing 15 percent of its food requirements.

There is no question that a ready market for food exists, but it appears that economic conditions are such that Massachusetts farmers are unable to adequately supply this market. As a result of the high import demand for food commodities, Massachusetts residents pay from 6-10 percent more for their food than the national average.

Consequently, the food prices in Boston are the fourth highest of the 38 major American metropolitan areas. These higher costs have been influenced by high transportation rates (with a decline in rail freight service, a greater reliance has been placed on more expensive trucking) and by the lack of storage facilities in the state.[8/]

It should be pointed out that there are only two food crops in the state wherein production exceeds consumption: sweet corn and cranberries. As a result, it may be necessary to introduce future programs whereby incentives can be generated to produce any given crop or a combination

of crops (land, climate, capital, and management permitting). Such a program could involve subsidies, for example, a guaranteed outlet at a guaranteed minimum price; tax incentives; promotion of farm cooperatives for food processing and marketing; erosion control; agricultural education; etc.

4.4 FOREST RESOURCE AND RELATED ECONOMIC ACTIVITY

4.4A Extent and Nature of the Resource

Forest land occupies 1,295,301 acres or approximately 73 percent of the 1,766,592 acres in the Connecticut River Region.9/

A forest is an association of tree species. The tree species associated on a specific land area are a function of soils, sites, climate, and cultural activities. Figure 4.1 shows the general association of trees in the region. Table 4.3 shows tree volume estimates by species and size classes in the region.

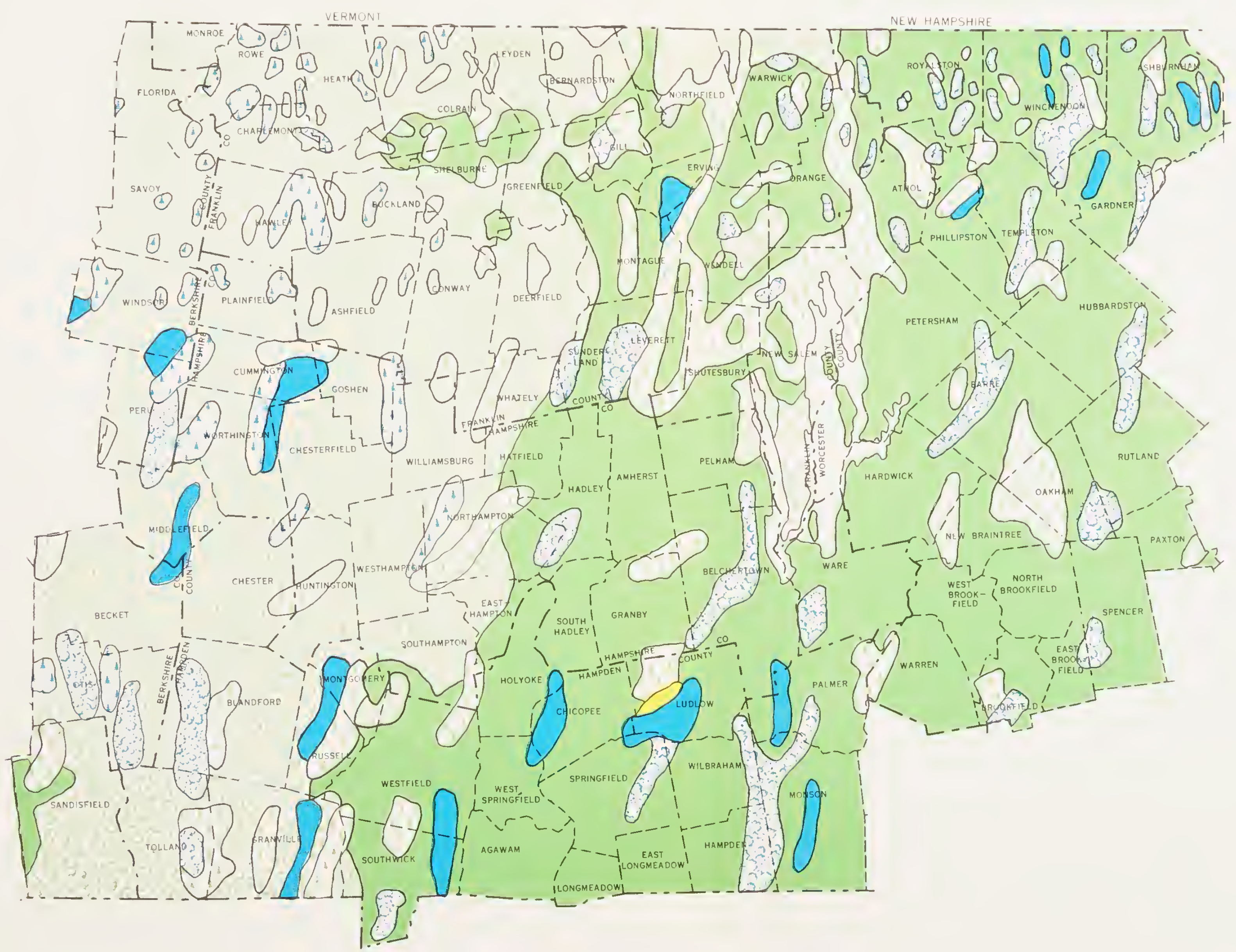
TABLE 4.3 ESTIMATED NET VOLUME OF GROWING STOCK ON FOREST LAND, BY SPECIES, TREE SIZE CLASSES - 1972

(In Millions of Cubic Feet)

Species	Total	Species	Total
White Pine	330.7	Paper Birch	43.9
Pitch Pine	21.4	Beech	44.1
Hemlock	117.4	White Ash	41.4
Other Softwoods	42.1	Black Cherry	41.8
Total Softwoods	511.6	Aspen	24.6
		Elm	6.9
Select White Oaks	62.3	Other Hardwoods	13.4
Select Red Oaks	181.9	Total Hardwoods	1003.1
Other Oaks	123.5		
Hickory	25.4	All Species	1514.7
Sugar Maple	99.7		
Soft Maples	229.6	Sawtimber	742.6
Sweet Birch	33.7	Poletimber	772.1
Yellow Birch	30.9	All Classes	1514.7

4.4B Utilization

The forest resource provides goods and services that benefit the region's economy and environment. These goods and services can be grouped to: wood products, water, forage, wildlife, and recreation.



LEGEND

- MAPLE-BEECH-BIRCH
- OAK-HICKORY
- WHITE AND RED PINE
- PITCH PINE
- ELM-ASH-RED MAPLE
- ASPEN-GRAY BIRCH
- SPRUCE-FIR
- QUABBIN RESERVOIR, SURFACE WATER SUPPLY

0 5 10 Miles

FIGURE 4.1

FOREST ASSOCIATION MAP

CONNECTICUT RIVER REGION
MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Wood Products[10/] -- The annual sawlog harvest is about 48 million board feet, valued at $5,204,000 delivered at the mill. The harvest is about equally divided between softwood (primarily white pine) and hardwood. Other round wood products are composed primarily of fuelwood and some pulpwood. Approximately 4,400 cords are harvested annually, valued at $88,000 delivered at the roadside.

Water[11/] -- Forest land is a source of good quality water. Precipitation falling on forest land is used by the vegetation, evaporated, stored in the soil, or leaves the watershed as streamflow. Streamflow is water yield. Forest land in the region yields 2,799,000 acre-feet (912 billion gallons) annually.

Forage[12/] -- There is very little grazing of livestock on forest land. It is unlikely that grazing will be a major use of forest land in the near future.

Wildlife[13/] -- Forest land is a valuable wildlife habitat. Each 100 acres of well managed eastern hardwood forest can support a fall population of: 3 turkey, 3 deer, 25 grouse, 50 rabbit, and 100 squirrel, a total of 180 game animals. In addition, it will support 200 fur animals.

Recreation[14/] -- Recreational activities can be divided into two broad categories, general and special. General recreation includes activities attractive to the majority of outdoor recreationists and which generally require the development and maintenance of convenient access and adequate facilities. Activities include picnicking, swimming, sightseeing, camping and hiking.

Special recreation includes activities for which opportunities, in general, are limited, intensity of use is low, and often may involve a large personal expense by the user. Activities include hunting, fishing, backpack camping, canoeing and snowmobiling.

There are approximately 3,513,000 visitor days annually of general recreation use on forest land in the region, valued at $7,026,000 and 2,285,000 visitor days of special recreation, valued at $11,425,000.

4.4C Current Growth

The forest resource is underutilized in terms of the potential cut for wood products. A measure of the potential is the growth-cut relationship. Growth is the volume of wood added annually to the inventory of wood, and cut is the volume of wood cut annually from the inventory of wood.

Growth averages about 50 cubic feet per acre annually while the cut for wood products averages about 6 cubic feet per acre annually. The growth to wood product cut ratio of 8:1 indicates that the cut could be increased substantially without touching the inventory base.

The growth-cut ratio, although useful as a gross indicator of the wood available, does not reveal other necessary factors about the resource such as quality of wood, that wood cut in land clearing operations and not used for wood products, the economics of harvesting, or the volume of wood offered for sale by the landowner. The critical factor appears to be that only about 50 percent of the forest land is available for wood products. Chapter 5 discusses land ownership and landowner attitudes in more detail.

4.4D Employment & Income in Primary & Secondary Wood Processing

The primary forest product industry--those companies manufacturing wood products from logs and bolts--is almost exclusively made up of sawmills. No pulp, cooperage or veneer industries operate in the region. Excluded here are companies or individuals manufacturing fuelwood from logs and bolts. In 1975, 60 commercial sawmills were located in the region.[15/] To supply sawmills with their logs, an estimated 61 logging operations are located in the region.

In 1975, approximately 180 people were employed in the sawmill and planing mill industry.[16/] Employee earnings in the sawmill industry are estimated at $1,260,000.

The secondary forest product industries--those companies using wood which has undergone some previous manufacturing process and use wood exclusively or partially in a further manufacturing process--is quite extensive in the region. These industries include such diversified manufactured products as hardwood dimension, pallets, millwork, structural wood members, wood boxes and shook, wood household furniture, paper and paperboard. In 1975, approximately 8,100 people were employed in these wood-based industries.[16/] Employee earnings in these industries are estimated at $8,100,000.

Employment in wood-based industries by Standard Industrial Classification Code (SIC) is shown in the following tabulation.

Major Group	Employees
24--Lumber & Wood Products (except furniture)	1,600
25-- Furniture & Fixtures	3,400
26--Paper and allied products	3,100
	8,100

4.4E Economic Factors Affecting Forest Resource

Forested land in the region is subject to pressure of urban and industrial developments, but not to the same extent as in the eastern part of the state. The value of forest land solely for the production of wood products cannot compete with the value of converting forest land to these type developments.

Forest land is owned for a variety of reasons. Many landowners do not consider forests as a renewable resource which can be utilized. The forest land is owned by many owners and the forested tracts are often too small for efficient management and timber production purposes. The combination of landowner attitudes and small forest land ownerships tends to discourage large scale wood operations which require a steady flow of wood.

4.5 TOURISM AND RELATED ECONOMIC SITUATION

In 1974, tourism in Massachusetts generated over $1.15 billion and contributed approximately 3.5 percent of the total income received in the Commonwealth from all sources. Employment utilized in the tourism industry amounted to more than 74,400 year round jobs.

A report entitled The Economic Impact of Tourism on the Commonwealth of Massachusetts stated the following: "There is probably no industry of any consequence to the Commonwealth--and certainly none as important as the tourism industry-about which so little is known."[17/] There are a number of possible reasons for this lack of information:

1. It is an industry with a very large number of enterprises--from giant hotels to part-time one person businesses.

2. Customers are not easily identifiable yet amount to some 33 million per year in the Commonwealth.

3. It is an industry whose product is a service, not a commodity.

4. It is an industry whose services are vastly diverse.

The report noted a rather interesting phenomenon concerning the tourism industry. One of the objectives of the study was to determine whether or not other New England states are competitive with Massachusetts, or if the region as a whole attracts the visitors. If it could be shown that the latter is the case, then the relationships of the New England states should be considered supportive, not competitive. The report concluded that visitors tend to come to individual states, rather than to the region as a whole. Visitors generally come to Massachusetts or to one or more of the other New England states. Although the report is a preliminary study, a table of total income generated by tourism in Massachusetts was developed. Table 4.4 summarizes the findings.

As can be seen tourism does play a rather significant role in the economy of Massachusetts. According to Professor Norman G. Cournoyer, University of Massachusetts, 1975 expenditures by non-Massachusetts travelers amounted to $957,680,000. In 1976, total expenditures on tourism amounted to $1,944,722,000. The Connecticut Region generated over $60.3 million in 1976, or 3.1 percent.

TABLE 4.4 TOTAL INCOME GENERATED BY TOURISM IN MASSACHUSETTS - 1974

	Accommodations					
	Commercial Lodging	Own Cabin, Trailer	Friends & Relatives	1/ Other	Day Trip	Total
	(thousands of dollars)					
Purpose of Trip						
Business	199,381	264	38,272	4,261	12,565	254,743
Personal Business	108,456	58,321	38,059	2,581	12,305	219,722
Convention	14,622	0	106	5,330	357	20,415
Visit Friends & Relatives	70,288	2,902	192,110	22,501	15,249	303,050
Recreation, Sightseeing, Entertainment	287,992	48,935	17,785	5,186	9,981	369,879
Total	680,739	110,422	286,332	39,859	50,457	1,167,809

Source: The Economic Impact of Tourism on the Commonwealth, op cit.

1/ "Other" includes nights on a cruise boat, or other special facilities for accommodation.

4.6 RELATIONSHIP BETWEEN ECONOMIC SITUATIONS AND NED SPECIFIC COMPONENTS

4.6A Land Use

The NED specific components are formulated to minimize the commitment of agricultural land to other uses. In looking at the economic situation for this particular resource area, attaining a goal of preservation of agricultural land is challenging. Due to the higher incomes possible from alternative employments, because of low returns to the agricultural enterprise, agricultural land is decreasing. Low returns are a result of inter-regional competition, land prices, tenure and land holding philosophies, physical characteristics of the land (soils, slopes, growing season length, etc.), and the marketing and processing infrastructure. It is obvious that a laissez-faire market policy in Massachusetts is not conducive to the maintenance of agricultural land. Thus, a public policy which would either artificially (subsidize) or directly impact upon the agricultural economic structure would be necessary. Application of the development rights program could potentially lower entry and tax costs, and change tenure and land holding to patterns that are more conducive to efficient agricultural operations.[6/] A long term application of the program should enhance the potential for economic growth of the agricultural marketing and processing infrastructure.

In discussing the forest land situation with respect to its NED specific components, similar economic conditions preclude optimism for obtaining objectives. Like the agricultural land resource area, the forest land area suffers from some adverse economic conditions which are due to inter-regional competition; tenure and land size holding patterns; reasons/philosophies for owning forest land; and minimal availability of primary, secondary, and tertiary wood processing firms. To attain the NED specific component of increased utilization of the forest resource, requires that an approach be formulated whereby forest land owners can see the "benefits" of increasing the utilization of the forest land resource.

4.6B Flooding

The specific NED components with respect to flooding involve the minimizing of flood damage. This can be accomplished by: structural measures, floodproofing existing property, guiding development away from flood-prone areas, and protecting wetland flood storage areas from filling or development. With respect to the present economic situation and the NED components, given the present enactments of both federal and state statutes, the attainment of the components is realistic from an economic point of view.

4.6C Wetlands

The NED components for the wetland resource area consist of protecting wetland flood storage from filling, protecting flood-prone areas from development, and increasing wetland recreation. Like flooding, given present local, state, and federal enactments and the present economic conditions attainment of the NED components is realistic.

4.6D Recreation

According to the state outdoor recreation report,[14/] the demand for recreation exceeds the available supply and thus, the NED specific component is to increase public access to outdoor recreation resources and to increase the recreational opportunities such that the divergence between supply and demand will be minimized. From an economic perspective, attaining the NED components is not an unwarranted goal. Obviously, if present state financial problems were to continue to exist at the level of the last 3 years, the attainment would be slow. Thus, economically, the condition of local and state finances will determine what proportions of the components are attained. Present enactments limit liability to those landowners who permit free public access to their recreation resource. The question comes to how much can the state afford to budget in the attempted attainment of the recreation objective.

4.7 ENVIRONMENTAL SITUATION

4.7A General Landscape

The variety of landforms range from the gently rolling hills and level flood plains and terraces along the Connecticut River to the slightly rugged hilly uplands to the east and the rugged Berkshire Hills to the west. Narrow, steep-sided stream valleys with headwater wetlands and large expanses of forest land, occasionally interrupted by agricultural land and small villages, form the general landscape of the upland areas. Urban areas are dominant in the southern one-third of the Connecticut River lowlands. To the north, large fields of tilled land, occasional wooded hills and ridges, small villages, and the tree-bordered Connecticut River are the major features of the lowland landscape.

4.7B Wetlands

The area has about 70,000 acres of wetlands which provide storage for floodwaters, maintain summer flows in the streams, serve as fish and wildlife habitat, and enhance visual quality.

In the 1960s, residents and governments began to realize that wetlands were being lost at an alarming rate. Developers were buying parcels of cheap swampland, hauling in fill and constructing shopping centers and housing tracts, and then departing to let the new owners be confronted with the problems of high-water tables, settling and cracking foundations, failing septic systems, periodic flooding and a host of related nuisances. In some cases, town governments themselves were unwitting co-conspirators in the loss of wetlands. Zoning regulations encouraged developers to build in many wetlands zoned for industrial or commercial uses. Some towns decided that these "useless swamps" would serve as good municipal dump sites. In addition, it became apparent that loss of natural flood storage in the wetlands was causing downstream flood peaks to increase, resulting in increased financial losses due to flooding. The loss of wetland wildlife habitat and its effect on certain species was not as dramatic as the other problems but was very real to knowledgeable observers.

To counter the loss of wetlands, pioneer legislation was introduced by Representative Francis Hatch. Even to this date, subsequent wetlands legislation is often referred to as "the Hatch Act" even though the original Hatch Act has seen many changes through the years. In addition to restriction laws, Massachusetts has a very active wetlands acquisition program. Two key state agencies involved are the Massachusetts Division of Forest and Parks and the Massachusetts Division of Fisheries and Wildlife. Cities and towns are also involved in wetland acquisition. Cost sharing funds for such community acquisitions are provided from the Massachusetts Self-Help Fund (GL Ch. 132A, Sec. 11) administered by the Massachusetts Division of Conservation Services. The various wetland restriction, control, and conservation measures now available to protect wetlands are described in detail in Chapter 5.

4.7C Surface Water

The Connecticut River Region has over 46,400 acres of fresh open water in addition to the 69,600 acres of wetlands.

Streams in the region vary from low gradient, meandering ones in the Connecticut Valley lowlands, to relatively steep, fast flowing streams in the uplands. Historically, development, especially industrial, has occurred along the streams. As populations and industry grew, the water quality of the streams deteriorated. Presently, water quality of streams is generally improving due to the efforts of the state, towns and industries and the public concern for the problem.

Most of the natural ponds and man made reservoirs, are relatively high in water quality and contribute to the region's environmental quality as well as its economy.

Surface water is used for local water supply in less than half of the towns in the region, and most of these also use ground water sources. However, about 90 percent of the developed municipal water supply for the region is from surface water sources. The largest surface water supply in the region is the Quabbin Reservoir, with a surface area of about 39 square miles. Most of the yield of this reservoir is diverted from the region. Within the region, Chicopee, South Hadley, and Wilbraham are supplied from Quabbin Reservoir through the Chicopee Valley Aquaduct. There are many sites in the region for constructing new surface reservoirs (see Appendix A). These sites may be needed in the future for recreation and water supply. There appears to be a desire on the part of the public to insure that demands for adequate recreation facilities as well as municipal water be met by government.

4.7D Population Distribution and Land Use Aspects

The population within the Connecticut River Region was 749,646 in 1975. With a total land area (excluding water and wetlands) of 1,681,940 acres (or 2,628 square miles) the population density was approximately 285 people per square mile (or 0.45 person per acre). Most of the population, as can be seen in Table 4.5, is concentrated in Hampshire and Hampden Counties. In the former, population density per square mile is equal to 246 persons, and in the latter, it is 805 persons per square mile. Historical population growth for each substudy area is summarized in Table 4.5. In absolute terms, the Hampshire County area of the region experienced the largest growth.

It is important to note that from an environmental perspective, there appears to be enough water and related land resources to satisfy future resource demands without resulting in the degradation of environmental quality. Such results can only be achieved, however, if future growth is guided away from environmentally sensitive areas to those locations which can adequately accommodate future developments. Also required

TABLE 4.5 POPULATION, LAND AREA, POPULATION DENSITIES, 1950, 1960, 1970, 1975

Study Area	1950	1960	Percent Change 1950-1960	1970	Percent Change 1960-1970	1975	Percent Change 1960-1975
Berkshire							
Population	2,836	3,206	13.05	4,014	25.20	4,915	53.31
Land Area (ac)	165,588	165,588		165,588		165,588	
Densities							
Persons/ac	0.02	0.02	0.00	0.02	0.00	0.03	50.00
Persons/sq mi	11	12	13.05	16	25.18	19	53.35
Franklin							
Population	52,747	54,924	4.13	59,210	7.80	63,420	15.47
Land Area (ac)	465,455	465,455		465,455		465,455	
Densities							
Persons/ac	0.11	0.12	9.09	0.13	8.33	0.14	16.67
Persons/sq mi	73	76	4.12	81	7.80	87	15.47
Hampshire							
Population	37,594	103,229	17.85	123,981	20.10	134,276	30.08
Land Area (ac)	348,957	348,957		348,957		348,957	
Densities							
Persons/ac	0.25	0.30	20.00	0.36	20.00	0.38	26.67
Persons/sq mi	161	189	17.85	227	20.10	246	30.08
Hampden							
Population	365,915	426,719	16.62	455,360	6.71	456,028	6.87
Land Area (ac)	362,486	362,486		362,486		362,486	
Densities							
Persons/ac	1.01	1.18	16.83	1.26	6.78	1.26	6.78
Persons/sq mi	646	753	16.62	804	6.71	805	6.87
Worcester							
Population	77,674	81,321	4.70	88,436	8.75	91,007	11.91
Land Area (ac)	424,106	424,106		424,106		424,106	
Densities							
Persons/ac	0.18	0.19	5.56	0.21	10.53	0.21	10.53
Persons/sq mi	124	130	4.70	141	8.75	145	11.91
Total Connecticut							
Population	586,766	669,399	14.08	731,001	9.20	749,646	11.99
Land Area (ac)	1,766,592	1,766,592		1,766,592		1,766,592	
Densities							
Persons/ac	0.33	0.38	15.15	0.41	7.89	0.42	10.53
Persons/sq mi	213	243	14.08	265	9.20	272	11.99

Source: Population figures from Table 2.1 - Land acreage from MacConnell et al.

is an enactment of means whereby desirable growth forms are permitted. For example, most agricultural and forested land is zoned for low density residential. Such ordinances result in extensive developments which consume not only large acreage but also provide the vehicle for urban sprawl and increased service requirements. Therefore, if a regional goal is to preserve agricultural land, and if zoning ordinances are not modified to permit more intensive uses of land (e.g., cluster developments, planned unit developments, etc.), it is doubtful whether preservation goals can be obtained.

4.8 PROJECTIONS

4.8A Methodology (Projection Procedures and Relationship to OBERS)

General -- A major objective of the Massachusetts Water Resource Study (MWRS) is to project a number of important variables (land use, population, income, etc.) and thereby identify areas that may experience potential problems. Once potential problems are recognized, alternative policies can be developed which have as their objective, the minimization of such problems.

The growth of any region and the quality and quantity of its water and related resources are closely interrelated. This is obvious when it is considered that new development creates demand for water (drinking, recreation, waste disposal) and land which may result in an encroachment upon ecologically and economically sensitive areas (e.g., flood plains, wetlands, and lands overlying aquifers). Projections are utilized to determine the extent and rate of development (or the decline therein) and whether or not increased demands upon the resource base can be met with a set of projected resource suppliers (water, land, transportation, etc.). Problems arise to the extent that critical resources of minimum quality and quantity can or cannot satisfy such demands. For example, federal and state land use policies have placed a high priority on the preservation of agricultural land (specifically, prime agricultural land). In the past, much of the development in the region has been at the expense of forest and agricultural land. Given the priorities on preserving such land, future growth and land demand give an indication of what is likely to occur, given recent trends. Such forward looking procedures also indicate the extent to which future growth must be guided.

Some of the economic activity-type projections were taken from OBERS projections, Series E, and were then disaggregated to more closely approximate the boundaries of the Connecticut River Region. In using the OBERS projections, the intentions thereof are clearly described by the Director of the Water Resources Council:

> The OBERS projections are intended as a planning tool, as a contribution to planning decisions. Wherever water and related land development problems may be solved by alternative levels of growth, through more or less resource development, full consideration should be given to such action, uninhibited by the projections contained in this report.
>
> The OBERS projections are not a goal. It is not intended that they be used as assigned shares, or quotas. They are not intended as a constraint on any region's economic activity. They do not express what is desirable or undesirable.[18/]

There are a number of assumptions utilized in the preparation of the OBERS Regional projections. These are specified in detail in Vol. I of the 1972 Series E OBERS. In some instances, these assumptions may or may not apply to any one particular region. State and local planners should compare those assumptions used in the formulation of the OBERS projections to determine which ones are applicable and the amount of adjustment needed to bring them into compliance with what exists in the region.

Population Projections -- There were two population projections available for use in this study. The first was the OBERS projections developed by the Bureau of Economic Analysis and the Economic Research Service, and the second source was the Regional Planning Commissions located in the Connecticut River Region. Although the two projection sources suggested similar rates of growth, projections supplied by the Regional Planning Commissions were used in this study. The primary reasons for this decision were:

1. The geographic configuration of the region presents many difficulties in accurately allocating various OBERS SMSA population data.

2. OBERS projections were developed using 1972 data, whereas the various planning commissions used up-to-date information and more recent trends for their projection base.

3. National projections are disaggregated first to states, then to regions, and finally to subregions. For each disaggregation, the probability of error increases correspondingly.

4. The Massachusetts Office of State Planning requires that regional planning commissions use a consistent methodology that differs from that used in OBERS projections.

Economic Projections -- Economic projections were taken from OBERS data as well as Office of State Planning data. In view of the fact that two different sources of data were used, complete uniformity was impossible. However, the direction and velocity of identifiable trends are more relevant considerations than simply absolute numbers. In this light, the fact that there may not be uniform comparisons should not detract from the validity of the analysis.

Land Use Projections -- A number of methodologies were utilized to project the various land use categories. Agricultural land was projected by using historical agricultural land data which were compiled from the 1949 through the 1974 Census of Agriculture. The data was weighted heavier in the latter years (1964 through 1974) to more accurately reflect recent trends. In some cases, it was necessary to allocate data from those counties which were located in more than one study region to the particular area included in the Connecticut River Region. The allocation was accomplished by using MacConnell's land use data to first determine the amount of agricultural land by category in each town in each respective region. Once these proportions were computed, they were then used to adjust the county census data to reflect that data located in each of the various regions. After the census data were adjusted for each substudy area, a Markov probability program was used to project the 1990 shares that each agricultural land use category contributed to the total land in farms. The total land in farms on the other hand was computed using two different methodologies: OBERS, Series E Report projections; and developing another Markov probability program. Each of these projected totals were then multiplied by the projected 1990 shares each agricultural land use category contributes to that total. It should be noted that the OBERS total land in farms projection is significantly higher than the Markov projection. This difference can be attributed to the methodology utilized in the OBERS projection and the fact that the Markov program is based solely upon historical relationships.

The State OBERS projections are based upon a National projection which were first disaggregated to a regional basis. The regional projections were then disaggregated further to generate state projections. On a National basis, recent trends in agricultural land have shown a leveling in agricultural land declines. Consequently, this leveling was reflected in both the regional and the state disaggregations. As a result, especially with respect to Massachusetts, the leveling aspect resulted in a much more optimistic projection than that suggested by the Markov probability projection.

Urban land was projected by using a log-linear regression model using MacConnell's land use data. Urban land was defined as industrial-commercial, residential, and institutional (schools, hospitals, etc.). The share of urban land by town and population density variables were

aggregated to the substudy area level. A number of regression equations were formulated and regressed. The "best" equation was utilized to project urban land acreage to 1990. In addition to MacConnell's data, population projections supplied by the various planning commissions in the region were also used. The population density model combined with historical urban land acreage was found to "fit the best." Base year data for 1951 and 1971 were used to estimate the regression coefficients for the entire Connecticut River Region. Similar regressions were also calibrated by substudy area to reveal regional differences. Weighted aggregations of these coefficients by region and by substudy area for 1951 and 1971 were used in the final regression model to project urban land use by subregion for 1990. This model is very efficient relative to larger land use models for it makes use of minimal data requirements. In addition, changing assumptions such as future population growth rates or per capita demand for land would require only simple adjustments to the model parameters.

Wetland projections to 1990 were based on historical trend analysis and adjusted to reflect the Wetland Restriction Acts presently in force in Massachusetts. Based on these factors, it was estimated that wetlands would decrease at the rate of .4 percent per year through 1990.

Forest land was projected by adjusting MacConnell's land use data to exclude woodland on farms and wooded wetlands identified by the Soil Conservation Service in 1976. Woodland on farms and wooded wetlands were subtracted from the 1972 forest land acreage because these two categories of land use are included in the agricultural land and wetland projections, respectively. The final projection dealt with the "other" land category. This category was the residual from all other acreage in the above land use categories.

4.8B Population and Economic Projections

Population -- Population projections gathered from the various Regional Planning Commissions in the Connecticut River Region show population increasing in all regions through 1990. At that time the regional population is expected to be approximately 826,318 people, an increase of 76,682 or 10.2 percent greater than the 1975 population. Thus, there will be an average of 3.41 percent increase in population every 5 years.

Table 4.6 summarizes the population projections for the Connecticut River Region.

TABLE 4.6 POPULATION PROJECTIONS, 1970-1990

Substudy Area	1970	1975	1980	1990
Berkshire	4,014	4,915	5,370	6,500
Franklin	59,210	63,420	65,800	68,800
Hampshire	123,981	134,276	142,147	154,731
Hampden	455,360	456,028	465,668	495,813
Worcester	88,436	91,007	96,308	100,474
Total	731,001	749,646	775,293	826,318
	- - - - - - - - - Regional Changes - - - - - - - - - -			
Years	1970-1975	1970-1990	1975-1980	1975-1990
Change	18,635	92,247	25,657	76,682
% Change	2.55	12.62	3.42	10.23

Source: Regional Planning Commissions.

Economic Projections -- The Office of State Planning has projected the employment by industry listed in Table 4.7. In the manufacturing sector, there was very little change between the 1975 and 1990 employment. Yet the 1980 employment figure suggests an increase of 2,800 between 1975 and 1980 and a decrease of nearly 1,800 people between 1980 and 1990. The Franklin County area shows a continuing decline in manufacturing from a 1975 figure of 5,136 to 4,771 in 1990. Worcester County follows the same trend. The Hampden County manufacturing employment figures, in terms of trend, corresponds closely to the Connecticut River Region. Only Hampshire County shows an increasing trend. In the service sector, the region is expected to experience a large continual increase in the number of employees from 45,501 to 68,608 for an increase of more than 23,000 people, or 50.8 percent. The region as a whole is expected to have an increasing employment for the period from 278,195 to 325,609 (47,414 employees) or an average increase of 17 percent.

Table 4.8 summarizes the 1975, 1980 and 1990 economic earnings by industry in the Connecticut River Region. Manufacturing is expected to increase from $619,326 in 1975 to $876,722 in 1990 (an increase of 41.6 percent). The service sector on the other hand is expected to increase from $331,165 in 1975 to $716,972 in 1990 (an increase of 116.5 percent).[19/] Although manufacturing is expected to remain the dominant economic sector in the region, the service sector is gaining rapidly.

TABLE 4.7 POPULATION, EMPLOYMENT/POPULATION RATIO, EMPLOYEES BY INDUSTRY, 1975, 1980 and 1990

		Substudy Area					
		Berkshire	Franklin	Hampshire	Hampden	Worcester	Total
Population, midyear, 1975		4,915	63,420	134,276	456,028	91,007	749,646
Employment/population ratio, 1975		.28	.29	.33	.41	.29	.37
		Employment					
Agriculture, forestry & mining							
	1975	6	316	476	1,099	215	2,112
	1980	6	275	398	1,027	262	1,968
	1990	5	200	340	797	269	1,611
Contract construction							
	1975	711	569	1,066	5,243	490	8,079
	1980	1,127	871	1,795	7,891	666	12,350
	1990	1,174	901	2,048	7,982	607	12,712
Manufacturing							
	1975	12	5,136	7,519	53,854	11,657	78,178
	1980	13	4,984	8,663	55,848	11,516	81,024
	1990	14	4,771	9,900	53,969	10,752	79,226
Transportation, communications & utilities							
	1975	18	927	754	7,939	599	10,237
	1980	22	1,061	864	8,792	661	11,400
	1990	30	1,132	962	9,007	732	11,863
Wholesale & retail trade							
	1975	30	3,576	7,256	40,166	3,673	54,701
	1980	35	4,135	8,626	46,231	4,039	63,066
	1990	42	4,713	10,883	51,603	4,280	71,521
Finance, insurance & real estate							
	1975	21	542	959	10,021	531	12,074
	1980	26	595	1,039	10,984	535	13,179
	1990	31	664	1,239	12,227	547	14,708
Services	1975	309	3,458	7,556	30,899	3,274	45,501
	1980	358	4,223	8,374	36,864	4,072	53,891
	1990	444	5,636	10,118	46,955	5,455	68,608
Government							
	1975	182	2,771	15,714	25,563	4,283	48,520
	1980	190	2,815	15,816	26,056	4,342	49,219
	1990	208	3,039	16,252	28,060	4,543	52,102
Other	1975	99	1,275	2,973	12,596	1,862	18,813
	1980	111	1,123	2,625	11,136	1,569	16,564
	1990	89	913	2,181	8,883	1,192	13,258
Total	1975	1,388	18,570	44,273	187,380	26,584	278,195
	1980	1,888	20,082	48,200	204,829	27,662	302,661
	1990	2,037	21,970	53,293	219,483	28,197	325,609

Projected employment by town, Massachusetts Office of State Planning.

TABLE 4.8 EMPLOYMENT EARNINGS PROJECTIONS BY INDUSTRY, 1975-1990

		Berkshire	Franklin	Hampshire	Hampden	Worcester	Total
		(X 1,000 1967 $)					
Agriculture, forestry, & mining	1975	62	3,248	4,893	11,297	2,210	21,709
	1980	78	3,563	5,157	13,308	3,395	25,501
	1990	89	3,563	6,057	14,198	4,792	28,698
Contract construction	1975	10,274	8,222	15,404	75,761	7,081	116,742
	1980	12,556	9,704	19,998	87,914	7,420	137,591
	1990	17,254	13,242	30,099	177,311	8,921	186,828
Manufacturing	1975	95	40,687	59,566	426,631	92,347	619,326
	1980	114	43,585	75,758	488,391	100,707	708,555
	1990	155	52,677	109,306	595,872	118,713	876,722
Transportation, communications & utilities	1975	158	8,123	6,607	69,569	5,249	89,707
	1980	208	10,049	8,183	83,269	6,260	107,969
	1990	380	14,320	12,169	113,939	9,260	150,067
Wholesale & retail trade	1975	148	17,669	35,852	198,460	18,148	270,278
	1980	183	21,651	45,166	242,066	21,148	330,214
	1990	262	29,428	67,953	322,209	26,724	446,577
Finance, insurance & real estate	1975	161	4,167	7,373	77,041	4,082	92,825
	1980	232	5,305	9,264	97,933	4,770	117,504
	1990	375	8,024	14,972	147,751	6,610	177,731
Services	1975	2,249	25,171	55,000	224,914	23,831	331,165
	1980	2,923	34,481	68,374	300,995	33,248	440,020
	1990	4,640	58,896	105,733	490,698	57,005	716,972
Government	1975	1,220	18,580	105,362	171,400	28,718	325,280
	1980	1,539	22,807	128,141	211,106	35,179	398,772
	1990	2,336	34,125	182,494	315,086	51,013	585,053

Source: Data computed from OBERS wage rates and Massachusetts Office of State Planning employment projections.

4.8C Land Use Projections

As discussed in 4.8A a number of methods were utilized to project various land use categories to 1990. These categories are as follows:

1. Agricultural land
   a. Total cropland
      (1) harvested cropland
      (2) pasture/grazing cropland
      (3) all other cropland
   b. Woodland
   c. All other farmland
   d. Total land in farms
2. Urban land
   a. Industrial-commercial land
   b. Institutional land
   c. Residential land
3. Open water areas
4. Wetlands
5. Forest land
6. All other land

Agricultural Land -- There are significant differences in the two projection techniques used for agricultural land. For reasons discussed in Section 4.8A, the OBERS projection should be considered the optimistic projection and the Markov projection should be considered the pessimistic projection. The data in Table 4.9 indicates the range of probable agricultural land acreage in 1990.

TABLE 4.9 AGRICULTURAL LAND USE, BY ACRES, 1974-1990, USING OBERS AND MARKOV PROBABILITY PROJECTION TECHNIQUES.

	1974 (acres)	1990 OBERS (acres)	1990 MARKOV (acres)	Difference between the two Projections
Total cropland	106,184	103,942	64,616	39,326
Harvested cropland	72,863	71,703	44,579	27,124
Pasture/Grazing cropland	25,966	26,160	16,261	9,899
All other cropland	7,354	6,079	3,776	2,303
Woodland on farms	105,487	90,306	56,132	34,174
All other farmland	33,199	34,120	21,213	12,907
Total land in farms	244,869	228,368	141,961	86,407

Which projection technique is more accurate? Given the methodology used in the OBERS report and the multitude of assumptions contained therein, the Markov technique more accurately reflects the trends that have recently occured in the Connecticut River Region. Such a projection suggests a drastic decline in agricultural land amounting to 102,908 acres (or a 42 percent decline between 1974 and 1990). Using the OBERS projection, the trend suggests a decline of 16,501 acres (or 6.7 percent decline). Dynamics of land use change, especially for a category which is declining at such a rapid rate usually show that the intensity of use on such land increases. As the intensity increases, the value of production increases which, theoretically at least, would suggest a decreasing rate of decline. Given the recent trends in agricultural land use decline, it appears that the actual 1990 agricultural land acreage will be very close to the Markov projection unless nonmarket influences, such as programs to preserve agriculture, have a significant effect.

The recent passage of the Massachusetts development rights program may have an impact upon the retention of agricultural land. When development rights to a particular farm are purchased, the value of the land would decrease from the development potential to a value derived from its agricultural production potential. As a result, the largest barrier to entry, namely the high cost of land would decrease substantially. In addition, taxes which were formerly derived from market-value assessments would be assessed on the agricultural value, and as a result, the cost of ownership would decrease. Further, "A supply of land from which development rights had been removed would create a 'market' for farmland at farm supportable prices in which a farmer who needed it could buy land to bring his operation to a more (economically) viable size."[20/]

<u>Urban Land</u> -- Projections to 1990 indicate that urban land will comprise 176,868 acres, an increase of 51,176 acres (40.72 percent) over the 1972 urban acreage which amounted to 125,692 acres. Thus, while urban land was approximately 7.1 percent in the Connecticut River Region in 1972, by 1990 it is expected to amount to 10 percent. In terms of the water and related land resource base, excluding environmentally sensitive areas (flood plains, wetlands, areas of unique and historic value, prime agricultural land), there is adequate land and water availability to support the projected 1990 population and the commensurate amount of urban land so generated.

<u>Water</u> -- The 1990 projection for open water area is expected to remain approximately the same as the 1972 figure of 58,076 acres.

<u>Wetland</u> -- Wetland projections to 1990 suggest that there will be a decline of 2,601 acres for a total decline of 5.6 percent (or .4 percent annually) between 1976 and 1990.

Forest Land -- Forest land is projected to remain relatively constant between 1972 and 1990. Although the trend between 1952 and 1972 showed an increase of approximately 1.5 percent in the forest land acreage, this trend is not expected to repeat itself for the period between 1972 and 1990.

Other Land -- The final projection dealt with the "other" land category. This category was projected as being the residual from all other acreage in the above land use categories (composition described in section 5.2). The 1990 OBERS projection amounts to 113,326 acres or a decline of 32,074 acres, representing a 62.28 percent loss. The 1990 Markov projection, however, calls for a figure of 199,733 acres representing a gain of 54,333 acres. The increase over the OBERS "other" land projection reflects the additional acreage available resulting from the Markov agricultural land projection. Table 4.10 summarizes the OBERS and Markov 1990 land use projections.

TABLE 4.10 LAND USE PROJECTIONS

Land Use Category	1972 Acres	199C OBERS	199C MARKOV	Change 1971-1990 OBERS	Change 1971-1990 MARKOV	Percent Change OBERS	Percent Change MARKOV
		Acres		Acres			
Agricultural Land	244,869 1/	228,368	141,961	-16,501	-102,908	-6.74	-42.03
Water	58,076	58,076	58,076	--	--	--	--
Wetland	46,449 2/	43,848	43,848	-2,601	-2,601	-5.60	-5.60
Forest Land 3/	1,146,106	1,146,106	1,146,106	--	--	--	--
Urban Land	125,692	176,868	176,868	51,176	51,176	40.72	40.72
Other Land	145,400	113,326	199,733	-32,074	54,333	-22.06	37.40
Total	1,766,592	1,766,592	1,766,592	--	--	--	--

1/ Agricultural land acreage is from the 1974 Agricultural Census.
2/ Wetland acreage is for 1976.
3/ Forest land acreage excludes woodland on farms and wooded wetlands.

NOTES

1/ Historical population figures were gleaned from town monographs (revised in July, 1973) published by the Massachusetts Department of Commerce and Development, Boston, Massachusetts. Projections were taken from population figures developed by the Regional Planning Commissions in the region.

2/ OBERS is an acronym for the Office of Business Economics (OBE--presently named Bureau of Economic Analyses, U.S. Department of Commerce) and the Economic Research Service (ERS--presently named Economics, Statistics, and Cooperatives Service, U.S. Department of Agriculture).

3/ Information garnered from Massachusetts Department of Commerce and Development Town and City Monographs, 1975. National per capita income was taken from U.S. Department of Commerce, Bureau of Economic Analyses, Local Area Personal Income.

4/ 1974 Census of Agriculture, Volume I, U.S. Department of Commerce. Social and Economic Statistics Administration, Bureau of the Census, Washington, D.C., April 1977.

5/ It should be noted that probably a large proportion of these farms are either part-time enterprises or enterprises which seek to accrue tax advantages. With the 1976 National Tax Acts, however, tax benefits over the near future will not be as large as they once were. Thus, one could expect that such enterprises would either be sold or simply not defined as farms in future censuses.

6/ Agricultural Preservation--Massachusetts General Laws, Chapter 232 and 780 of the Acts of 1977.

7/ A Policy for Food and Agriculture in Massachusetts, Executive Office of Environmental Affairs, Department of Food and Agriculture (Boston: 1967), p. 6.

8/ Christensen, Robert L., John H. Foster, and Donald R. Marion, Self-Sufficiency for Food in Massachusetts (Part II), Cooperative Extension Service, University of Massachusetts, U.S. Department of Agriculture and County Extension Services Cooperating (Amherst, Massachusetts) 1976.

9/ MacConnell, William P., and William Niedzwiedz, Remote Sensing 20 Years of Change in Worcester County, Massachusetts 1951-1971, Research Bulletin Number 625, Massachusetts Agricultural Experiment Station, Amherst, Massachusetts, November 1974 and similar publications by MacConnell et al., for Berkshire, Franklin, Hampden, and Hampshire Counties, (MacConnell Land Use Data).

10/ Bones, James T, 1973, "Primary Wood Product Industries of Southern New England," USDA, Forest Service, Resource Bulletin NE-30. Updated to 1976 through interviews with Massachusetts Service Foresters.

11/ NARWRCC, 1972, North Atlantic Regional Water Resources Study, Appendix C, Climate, Meteorology and Hydrology.

12/ From interviews with Massachusetts Service Foresters.

13/ Shaw, Samuel and David Gansner, A paper on "Incentives to Enhance Timber and Wildlife on Private Forest Lands," 1976.

14/ Massachusetts Division of Conservation Services, Massachusetts Outdoor Recreation Plan, Boston, Massachusetts, 1973 and interviews.

15/ Directory of Commercial Sawmill Operators and Loggers in Massachusetts, 1975. Cooperative Extension Service, University of Massachusetts.

16/ Massachusetts Industrial Directory 1974-75, Massachusetts Department of Commerce and Development, Boston, Massachusetts.

17/ Department of Hotel, Restaurant and Travel Administration, University of Massachusetts at Amherst, The Economic Impact of Tourism on the Commonwealth of Massachusetts, prepared for the Department of Commerce and Development, State of Massachusetts (Amherst, Massachusetts, December 1974), p. 1.

18/ 1972 OBERS Projections, Regional Economic Activity in the U.S., Series E, U.S. Water Resources Council, Washington, D.C., 1974.

19/ 1972 OBERS Projections and Massachusetts Office of State Planning.

20/ To Save the Farms, Benefits from Farmland, Interim Report of the Agricultural Land Preservation Committee, October 1976, p. 5.

CHAPTER 5

RESOURCE BASE
and
EXISTING PROGRAMS

5.1 RESOURCE BASE

5.1A General

The Connecticut River Region is the Connecticut River drainage within Massachusetts, encompassing an area of about 2,760 square miles. It is bounded on the west by the basins of the Hudson and Housatonic Rivers in the Berkshire Region. On the east, it is bounded by the basins of the Merrimack, Blackstone, and Thames Rivers which are within the Central Region.

Principal tributary drainages within the Connecticut River Region, which have been designated as Study Areas, include: all of the Chicopee River watershed; major portions of the Deerfield, Millers, and Westfield Rivers watersheds; and the headwater drainage of the Farmington River. The remainder of the region consists of parts or all of many small watersheds which flow directly into the Connecticut River. These small watersheds have been grouped into the Northern, Central, and Southern Connecticut Valley Study Areas.

Major streams within the Study Areas of the Connecticut River Region are:

Study Area	Major Streams
Chicopee	Swift River
	East Branch - Swift River
	Middle Branch - Swift River
	West Branch - Swift River
	Ware River
	Burnshirt River
	West Branch - Ware River
	East Branch - Ware River
	Danforth Brook
	Quaboag River
	Fivemile River
	Sevenmile River
	Chicopee Brook
	Chicopee River

Study Area	Major Streams
Deerfield	Green River
	Cold River
	North River
	South River
	Chickley River
	Clesson Brook
	Deerfield River
Millers	Otter River
	Tully River
	Moss Brook
	Keyup Brook
	Millers River
Westfield	East Branch - Westfield River
	Middle Branch - Westfield River
	West Branch - Westfield River
	Moose Meadow Brook
	Bradley Brook
	Russell Brook
	Little River
	Munn Brook
	Powdermill Brook
	Great Brook
	Paucatuck Brook
	Westfield River
Farmington	West Branch - Farmington River
	Clam River
	Buck River
	Sandy Brook
	Hubbard River
Northern Connecticut Valley	Pauchaug Brook
	Falls River
Central Connecticut Valley	Russellville Brook
	Sawmill River
	Mill River (Northampton)
	Mill River (Hatfield)
	Mill River (Hadley)
	Fort River
	Broad Brook
	Manhan River
	Bachelor Brook
	Stoney Brook

FIGURE 5.1

THE CONNECTICUT RIVER REGION

MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Iowa-Cedar Rivers Basin Study

U.S. DEPARTMENT OF AGRICULTURE
Forest Service
Soil Conservation Service
Economic Research Service

Study Area	Major Streams
Southern Connecticut Valley	Mill River (Springfield) Scantic River

The Connecticut River Region consists of 94 cities and towns. All of Franklin and Hampshire Counties, all but three towns in Hampden County, and portions of Berkshire and Worcester Counties are within the region.

The region's population is concentrated in the cities and towns along or near the Connecticut River. The highest concentration is in the cities of Springfield, Holyoke, and Chicopee where about 37 percent of the region's estimated population of 750,000 persons reside. Apart from the population centers along the river, the region is predominantly rural.

Region boundaries were originally selected on the basis of hydrologic boundaries being natural dividing lines for a study of water and related land resources. Because of the importance of municipal governments in planning and implementing measures, it was decided to adjust the hydrologic region boundaries so that all of a town's area could be assigned to one region. The towns and cities which were included in the Connecticut River Region are shown on Figure 5.1.

5.1B Soils of the Region

The soils of the Connecticut River Region have formed in materials influenced by glaciation. The region's many upland hills, drumlins and ridges are covered with two or three feet of friable, loamy material underlain by firm, loamy or sandy, hetergeneous glacial till. Stones and boulders are normal surface features in wooded areas. Bedrock outcrops are especially common on steeper slopes.

Intermingled with the uplands, in valleys and lower positions, are soils formed in materials influenced by glacial meltwater. These areas range from nearly level to moderately steep with shorter slope lengths than the nearby upland hills. Soils in these areas are quite varied, but practically all have substrata of sand or sand and gravel. The surface soil and subsoil portions may be silty, loamy or sandy and contain varying amounts of gravel.

Near the major rivers are soils formed in flood plain sediments. These soils are silty and nearly level. Soils in a few areas in the Valley formed in old silty lakebeds.

The General Soil Map for the Connecticut River Region (Figure 5.2) indicates ten broad groups or associations of soils.

1. Paxton-Hollis-Canton association

The soils in this association formed in glacial till deposits. They occupy gently sloping to steep land forms of drumlins and ridges throughout the uplands of the region. These soils have fine sandy loam surfaces. The surfaces of wooded areas often have many scattered stones and boulders. Bedrock outcrops are common in some areas, primarily on the steeper slopes. These soils are well drained to somewhat excessively drained and are free of problems associated with soil wetness.

This association is dominated by three major soils. The Paxton soils have loamy, slow permeable substrata. They make up about 50 percent of the association. The shallow to bedrock Hollis soils constitute about 15 percent. The Canton soils have sandy permeable substrata and are about 10 percent of the association. About 25 percent of the association consists of numerous minor soils.

2. Hinckley-Windsor-Muck association

The soils in this association formed in water sorted materials, primarily glacial outwash, and in pockets of organic materials. They are generally in the valleys on nearly level to rolling terraces, deltas, kames, and eskers. Numerous areas of this association are suited for agriculture. Many soils in this group are free of water table problems and in fact are limited by droughtiness. Muck soils are too wet for most crops.

This association is dominated by three major soils. The permeable Hinckley soils have sandy or sandy and gravelly substrata. They constitute about 40 percent of the association. The Windsor soils have sandy subsoils and are also very permeable. They make up about 30 percent of the unit. The wet organic Muck soils make up about 10 percent of the area. A number of other minor soils make up the remaining 20 percent.

3. Lyman-Marlow-Peru association

The soils in this association formed in glacial till derived primarily from mica, schist and granite rocks. They occupy gently sloping to steep drumlins, ridges, and low mountain forms in the western part of the region. These land forms are at higher elevations than most other associations, and the soil temperature is colder. The surfaces of wooded areas often have many scattered stones and boulders. Bedrock outcrops are common in some areas, primarily on the steeper slopes. These soils are somewhat excessively drained to moderately well drained. Wetness is a problem only in the Peru soils.

This association is dominated by three major soils. The Lyman soils are loamy and shallow to bedrock. They make up about 30

LEGEND

SOIL ASSOCIATIONS

1 PAXTON–HOLLIS–CANTON
2 HINCKLEY–WINDSOR–MUCK
3 LYMAN–MARLOW–PERU
4 SCITUATE–ESSEX–RIDGEBURY
5 WESTMINSTER–BUCKLAND–COLRAIN
6 HINCKLEY–WETHERSFIELD–WINDSOR
7 HADLEY–WINOOSKI–LIMERICK
8 WINDSOR–POLLUX–AMOSTOWN
9 HOLYOKE–HOLLIS–WETHERSFIELD
10 NASSAU–BERNARDSTON–PITTSTOWN

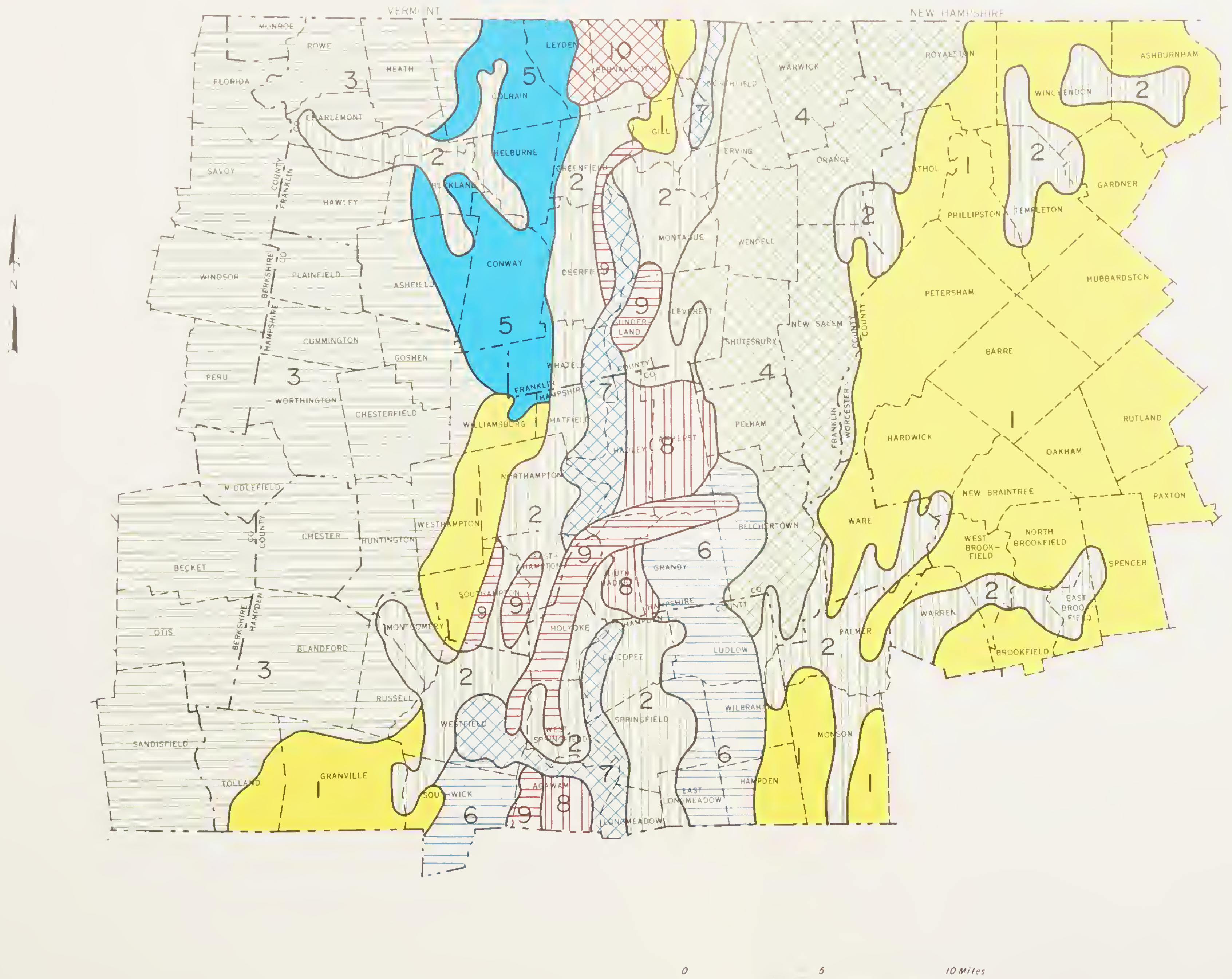


FIGURE 5.2

GENERAL SOIL MAP

CONNECTICUT RIVER REGION

MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

percent of the association. The Marlow soils and Peru soils both have loamy, slowly permeable substrata. Marlow soils constitute about 30 percent of the association. About 20 percent is Peru soils. A number of minor soils make up the remaining 20 percent.

4. Scituate-Essex-Ridgebury association

The soils in this association formed in glacial till. They occupy nearly level to sloping drumlins, ridges, and associated swales in the east central part of the region. The surfaces of wooded areas often have many scattered stones and boulders. The major soils have compact slowly permeable substrata. The Scituate and Essex soils substrata are loamy sand. Ridgebury substrata is sandy loam. The seasonal high water table persists for a number of months in the Ridgebury soils.

Three major soils are dominant in this association. The moderately well drained Scituate soils have a fine sandy loam mantle over the sandy substrata. They make up about 40 percent of the association. The well drained Essex soils have loamy sand texture dominant in both the subsoil and substratum. About 30 percent of the association consists of Essex soils. The poorly drained Ridgebury soils make up about 20 percent of the association. A number of minor soils constitute the remaining 10 percent.

5. Westminster-Buckland-Colrain association

The soils in this association formed in glacial till derived from schistose rocks and some intermingling of limestone. They occupy gently sloping to steep drumlins, ridges, and low mountains in the west central part of the region. The elevations of these land forms are higher than other associations to the east, and the soil temperatures are colder. In wooded areas, stones and boulders are commonly scattered on the surface. Bedrock outcrops are common in some areas, primarily the steeper slopes. Soil wetness is not much of a problem on these soils, although the Buckland soils have a seasonal high water table for part of the year.

Three soils are dominant in this association. The loamy Westminster soils are shallow to bedrock. They make up about 30 percent of the association. The Buckland soils have loamy, slowly permeable substrata. Some 30 percent of the association are Buckland soils. Colrain soils have loamy permeable substrata. They make up about 20 percent. Other minor soils constitute about 20 percent of the association.

6. Hinckley-Wethersfield-Windsor association

This association consists of soils formed in water sorted glacial outwash as well as glacial till. These contrasting materials are closely intermingled in two small areas in the south central part

of the association. The soils are on nearly level to undulating outwash plains and gently sloping to moderately steep upland ridges. Wooded areas of Wethersfield soils often have surface stones, and bedrock outcrops are in some areas. The lower slopes of Wethersfield soils are suited to agriculture. Droughtiness can be a problem for Hinckley and Windsor soils. Soil wetness is not a problem on these soils. The Hinckley and Windsor soils have permeable sandy substrata. Wethersfield soils have compact, slowly permeable substrata.

Three soils dominate this association. It is composed of about 40 percent Hinckley soils, 30 percent Wethersfield soils, and 15 percent Windsor soils. Other minor soils make up the remaining 15 percent.

7. Hadley-Winooski-Limerick association

This association consists of soils formed in silty alluvial deposits. They occur on the nearly level flood plains of the Connecticut and Westfield Rivers in the central part of the region. Texture throughout these soils is silt loam or very fine sandy loam. These are excellent agricultural soils. Unless protected, however, they are subject to flooding when the rivers overflow their banks. The Hadley soils are free of water table problems, but Winooski and Limerick are not. Limerick soils are particularly hampered by wetness.

Three major soils are dominant in this association. Hadley soils constitute about 50 percent of the association, Winooski soils about 30 percent, and Limerick soils about 10 percent. Other minor soils make up the remaining 10 percent of the association.

8. Windsor-Pollux-Amostown association

The soils in this association formed in water sorted glacial outwash or old lake deposits. They are in the Connecticut Valley on nearly level to undulating plains and deltas. There are two areas in the region--one near the center, and a smaller one in the south central part. Many areas of this association are suited to agriculture, although the Windsor soils tend to be droughty. Windsor and Pollux soils are free of wetness problems. The Amostown soils have a seasonal high water table for short periods of the year.

The three major soils in this association consist of the excessively drained, sandy permeable Windsor, the well drained Pollux, and the moderately well drained Amostown. Pollux and Amostown soils have silty substrata with partially restricted permeability. The association is composed of about 40 percent Windsor soils, 25 percent Pollux soils, and 15 percent Amostown soils. Other soils in the association make up about 20 percent.

9. Holyoke-Hollis-Wethersfield association

This association consists of soils dominantly formed in thin glacial till over basalt, sandstone, or conglomerate bedrock. They occupy moderately sloping to very steep hills and mountains. They are in five small narrow areas in the central part of the region. These areas are dominantly wooded. Stones and boulders are commonly scattered about the surface. Rock outcrops are especially common in the areas of the shallow to bedrock Holyoke and Hollis soils. The Wethersfield soils are deep, loamy, and have a compact substrata. They usually are on the lower slopes of this association. Wetness is not a problem in these soils.

This association is named for the three dominant soils occurring in it. Holyoke soils make up about 40 percent of the association, Hollis soils about 20 percent, and Wethersfield soils about 20 percent. The remaining 20 percent consists of several minor soils.

10. Nassau-Bernardston-Pittstown association

The soils in this association formed in glacial till derived chiefly from dark colored phyllite, slate, and schist rocks. They occupy gently sloping to steep drumlins and ridges in a small area in the extreme north central part of the association. Wooded areas often have many stones and boulders scattered over the surface. Bedrock outcrops are common in some areas, primarily on the steeper slopes. A high water table is a consideration only on the Pittstown soils.

Three major soils dominate this association. The Nassau soils are loamy and shallow to bedrock. About 35 percent of the association is Nassau soils. The Bernardston and Pittstown soils have loamy, slowly permeable subsoils. Bernardston soils make up about 25 percent, and Pittstown soils about 20 percent of the association. The remaining 20 percent consists of several minor soils.

5.1C Geology

The Connecticut River Region includes portions of two sections of the New England Physiographic Province. These are the New England Upland Section and the Connecticut Valley Lowland Section. The geology of the region is closely related to physiographic section. Therefore, each section is discussed separately.

New England Upland:

Topography in the New England Upland Section is rugged and hilly, with narrow, steep-sided stream valleys. The overall aspect of the topography is related to the erosion-resistant nature of the underlying

bedrock. However, the local topographic details were strongly influenced by glaciation during the Pleistocene Epoch.

Bedrock in this section includes Pre-Cambrian and Paleozoic gneisses, schists, and granitic intrusives. The occurrence and distribution of the different rock types is often quite complex and difficult to predict. Locally, the gneisses or granites are suitable for crushed stone or dimension stone, and have been so utilized in the past. These rock types are not being used for these commercial purposes today. The bedrock is generally hard and relatively watertight, except for local broken zones. Water wells in the bedrock are often unsuccessful, and individual producing wells generally yield only enough water for one or two families.

Unconsolidated materials are generally of glacial origin. Wherever the bedrock is not exposed at the ground surface, the crests and flanks of the hills are generally covered by a few feet of glacial till--a dense mixture of clay, silt, sand, gravel, and boulders. The till was deposited during the advance and retreat of the great Pleistocene glaciers. As the glaciers melted, streams deposited their loads of sand and gravel in old stream valleys and in natural sediment traps formed by blocks of glacial ice. Locally, ice and other debris created dams, and small ponds were formed. These ponds were filled with sand, silt, and clay.

The sand and gravel deposits are extensively developed in only a few localities, where they occur as deposits, filling preglacial valleys in the bedrock. These deposits may be up to 100 or 200 feet thick. The ground water prospects at such localities are quite good, and a few towns are beginning to utilize this resource. The sand and gravel are also used in construction. However, large boulders often present in these deposits make quarry operations more difficult.

<u>Connecticut Valley Lowland</u>:

The topography in the Connecticut Valley Lowland Section is characterized by a combination of gently rolling hills, large broad terraces, and large expanses of flatlands. These features are locally interrupted by long, narrow ridges of rugged mountains. Streams are generally meandering and have flat gradients. In some places, the terraces have been deeply dissected by the streams.

Bedrock in this section consists mostly of Triassic siltstone, sandstone, conglomerate, and basalt. Locally, Paleozoic and Pre-Cambrian metamorphic rocks are found in a few of the small hills. The Triassic rocks, with the exception of the basalt, are less resistant to erosion than the rocks in the Upland Section. The basalts occur in the narrow mountain ranges (e.g., Holyoke Range) which interrupt the otherwise low-lying nature of the topography. The basalt is quarried for its high value as crushed stone. The sandstone has been used as flagstone in some places, but is generally not as durable as flagstone obtained

in other parts of the country. The siltstone and sandstone contain excellent plant fossils and dinosaur footprints. The ground water potential of the bedrock probably is not great, especially when it is compared to the potential of the unconsolidated surficial deposits.

Glacial till is not encountered as frequently as it is in the Upland Section. The till is a dense mixture of clay, silt, sand, gravel, and boulders, but is not as stony as the till in the Upland. It is found on the crests and flanks of the gently rounded hills, and is present in the subsurface beneath other unconsolidated deposits.

Deposits formed during the melting of the glaciers dominate the surficial geology of the Connecticut Valley. At least two huge interconnected glacial lakes were once present in the valley. One extended from the Holyoke Range northward to the Massachusetts-Vermont state line. The other, to the south of the Holyoke Range, was the northern end of a large lake in Connecticut. Thick deposits of varved silt and clay accumulated on the bottoms of the lakes. Terraces and deltas of sand and gravel were deposited at the margins of the lakes.

The thickness of the surficial deposits is variable, indicating the rugged topography of the bedrock surface. The deposits are several hundred feet thick where they fill the ancient channel of the Connecticut River. Places such as this, in addition to the thicker terrace and delta deposits, have a very favorable ground water potential. Several towns in the Connecticut Valley are now using or considering ground water as an important part of their water supply. The sand and gravel is also used for construction material.

Only a few relatively low intensity earthquakes have been reported in this region of Massachusetts. However, earthquakes have occurred relatively frequently near Hartford, Connecticut, and in a zone in northeastern Massachusetts-southeastern New Hampshire. A few damaging earthquakes have occurred in these more seismically active areas. Therefore, the possibility of damaging earthquakes occurring in the Connecticut River Region should be considered when designing major engineering works. No active faults have been recognized in the study, but this does not preclude the possibility of some being present.

5.1D Vegetative Cover

Approximately 93 percent of the region is in nonurban uses. Forest land is by far the most dominant, with 1,295,301 acres or 73 percent of the total area. The remainder of the nonurban land (20 percent) can be divided into cultured lands with agricultural crops, including grasses and legumes, and noncultured land. Hardwood forest is the dominant forest vegetation type; approximately two-thirds of the forest volume is in hardwoods. The major hardwood species are oaks, particularly red oaks, and maples. The major softwood species are white pine and hemlock. Wetlands and transitional lands such as abandoned fields

and orchards are the major examples of noncultured lands. If left alone, the transition lands will ultimately revert to forest through natural plant succession.

5.1E Climate

The average annual temperature is about 49° Fahrenheit (°F). Temperatures vary depending on the elevation, slope, and other environmental aspects, and have been recorded from lows of -30°F to highs of over 105°F. The growing season (frost-free period above 32°F threshold) averages from 120 to 160 days.

Mean annual precipitation varies within the region from 40 to 50 inches, and is rather evenly distributed throughout the year. Snowfall averages from 50 to 80 inches. Topography has a marked influence on snowfall causing much variation in relatively small geographical areas. The average annual runoff is about 23 inches, or about one-half of the annual precipitation. See Figures 5.3, 5.4, and 5.5 for average annual precipitation, growing season, and snowfall.

5.1F Storms and Droughts

Major storms have occurred in nearly every month of the year. One of the most serious types of storms, "Northeasters," occurs most frequently in fall, winter, and spring. They generate very strong winds and heavy rain or snow. In winter, these storms produce the heaviest snow, and during fall and spring are one of the more frequent causes of flooding. Some of the severest floods have been those associated with hurricanes and storms of tropical origin in late summer or early fall. The more significant flood producing storms of this century were the hurricanes of September 1938, August 1955, and September 1960. Other storms which caused flooding occurred in November 1927, March 1936, November 1953, March 1963, and March 1968.

Droughts have occurred in the region, with the longest in recent history extending from 1962 to 1967. About half of the average annual runoff was realized in 1965, the year of minimum recorded runoff.

Stream gage data from U.S. Geological Survey Stations throughout the region is abstracted in Table 5.1.

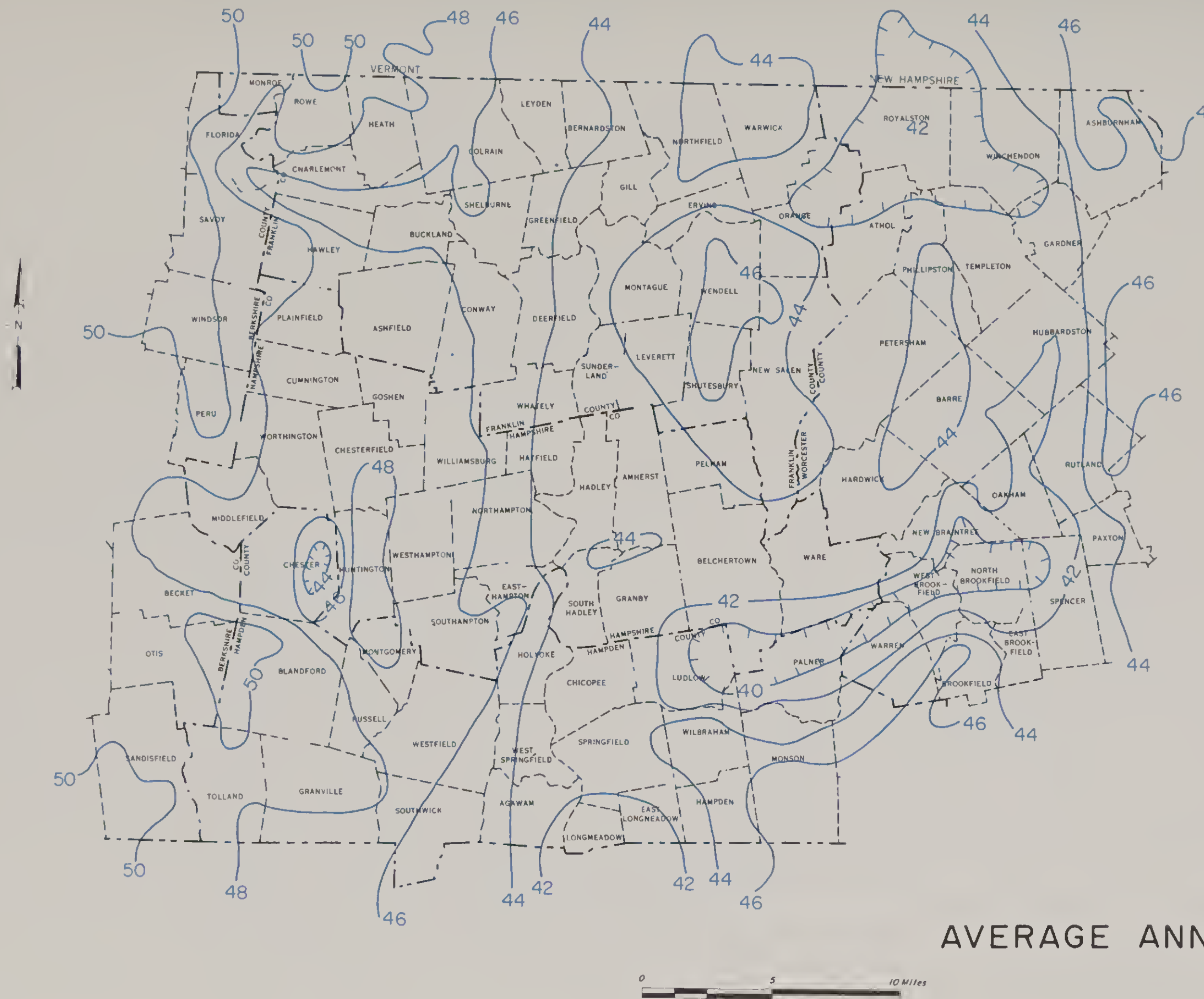


FIGURE 5.3

AVERAGE ANNUAL PRECIPITATION

(INCHES)

CONNECTICUT RIVER REGION

MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

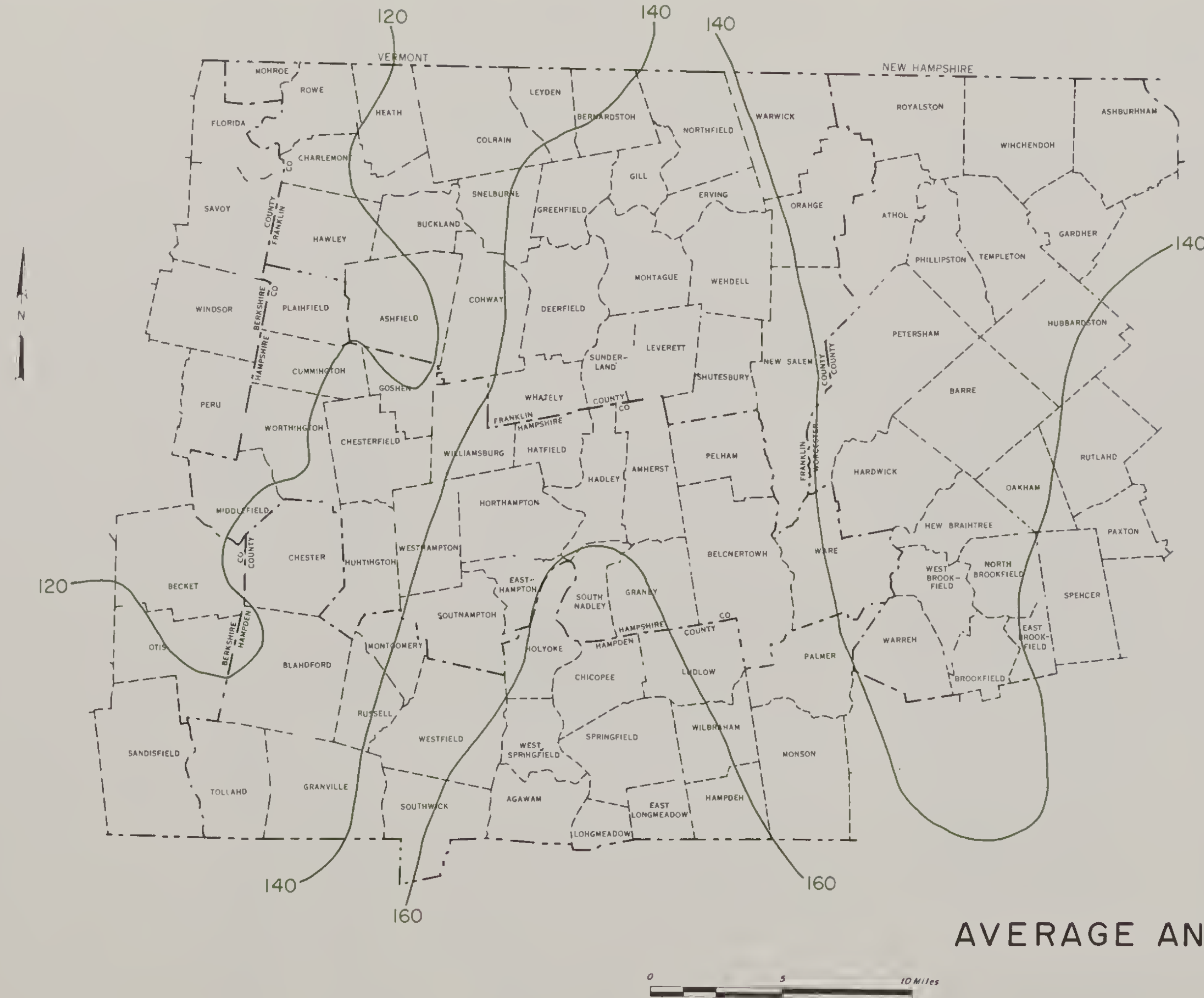


FIGURE 5.4

AVERAGE ANNUAL GROWING SEASON

(DAYS)

CONNECTICUT RIVER REGION

MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
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FIGURE 5.5

AVERAGE ANNUAL SNOWFALL
(INCHES)

CONNECTICUT RIVER REGION
MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
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TABLE 5.1

STREAM GAGE DATA CONNECTICUT RIVER BASIN STATIONS

USGS Stream Gage Number	Location	Drainage Area (sq mi)	Period of Record	Average Flow C.F.S.1/	Minimum Flow		Maximum Flow		
					C.F.S.	Date	C.F.S	C.S.M.2/	Date
01161500	Tarbell Brook near Winchendon	18.2	May 1916 - current	29.4	0.1	August 24, 1924	2,630	144.5	September 21, 1938
01162000	Millers River near Winchendon	83.0	June 1916 - current	143	0	September 20, 1918	8,500	102.4	September 22, 1938
01162500	Priest Brook near Winchendon	19.4	May 1916 - current	32.6	0.08	September 1929	3,000	154.6	September 21, 1938
01163200	Otter River @ Otter River	34.2	December 1964 - current	60.9	2.2	August 13, 1974	714	20.9	December 22, 1973
01164000	Millers River @ S. Royalston	187.0	July 1939 - current	319	9.3	August 4, 1956	2,830	15.1	June 25, 1944
01165000	E. Branch of Tully River near Athol	50.4	October 1915 - current	81	0.01	November 7, 1961	5,140	102.0	September 21, 1938
01165300	Lake Rohunta Outlet near Athol	20.3	December 1964 - current	35.5	0.17	June 3, 1971	496	24.4	June 29, 1972
01165500	Moss Brook @ Wendell Oepot	12.3	June 1916 - current	20.1	0.2	September 4, 1929	1,540	125.2	March 19, 1936
01166500	Millers River @ Erving	375.0	August 1914 - current	624	8.0	September 6, 1926	29,000	77.3	September 22, 1938
01167000	Connecticut River @ Turners Falls	7163.0	January 1915 - current	11,850	Flow regulated by power plants				
01167800	Beaver Brook @ Wilmington, Vt.	6.39	February 1963 - current	15.7	0.06	August 1, 1965	1,170	183.4	August 10, 1976
01168151	Oeerfield River near Rowe	254	May 1974 - current	-	42.0	February 17, 1975	16,400	64.6	August 10, 1976
01168500	Deerfield River @ Charlemont	362	June 1913 - current	894.0	5.0	June 17, 1921	56,300	156.5	September 21, 1938
01169000	North River @ Shuttuckville	88.4	October 1939 - current	181	5.1	October 3, 1948	13,200	149.3	October 15, 1955
01169900	South River near Conway	24.0	June 1966 - current	55.4	3.0	September 2, 1966	2,480	103.3	Oecember 21, 1973
01170000	Oeerfield River near W. Oeerfield	558	October 1940 - current	1,280	28	July 29, 1962	48,500	86.9	Oecember 31, 1948
01170100	Green River near Colrain	41.4	October 1969 - current	98.9	1.9	August 1, 1968	4,560	110.1	Oecember 21, 1973
01170500	Connecticut River @ Montague City	7865	March 1904 - current	13,720	215	August 31, 1958	236,000	30.0	March 19, 1936
01171300	Fort River near Amherst	36.4	June 1966 - current	65.3	1.9	-	2,820	77.5	Oecember 21, 1973
01171500	Mill River @ Northampton	54.0	October 1938 - current	95.6	4.2	August 21, 1957	6,300	116.7	August 19, 1955
01172500	Ware River near Barre	55.0	July 1946 - current	91.0	0.5	September 11, 1963	1,890	34.4	October 16, 1955
01173000	Ware River @ Coldbrook	96.9	January 1928 - current	164.0	1.1	September 19, 1965	1,470	15.2	April 1, 1962
01173500	Ware River @ Gibbs Crossing	199	August 1912 - current	289	6.0	October 4, 1914	4,240	21.3	January 20, 1976
01174000	Hop Brook near New Salem	3.39	October 1947 - current	6.06	0.004	August 3, 1955	289	85.3	October 24, 1959
01174500	East Branch of Swift River near Hardwick	43.7	January 1937 - current	68.3	0	-	6,780	155.1	September 21, 1938
01174600	Cadwell Creek near Pelham	0.63	July 1961 - current	1.14	0	-	38	60.3	September 29, 1975
01174900	Cadwell Creek near Belchertown	2.81	July 1961 - current	4.71	0.07	1964	239	85.1	September 21, 1973

TABLE 5.1 - cont. STREAM GAGE DATA CONNECTICUT RIVER BASIN STATIONS

USGS Stream Gage Number	Location	Drainage Area (sq mi)	Period of Record	Average Flow C.F.S.1/	Minimum Flow		Maximum Flow		
					C.F.S.	Date	C.F.S.	C.S.M.2/	Date
01175500	Swift River @ West Ware	188	October 1912 - current	92.4	9.1	December 15, 1968	1,870	9.9	April 30, 1956
01175670	Sevenmile River near Spencer	8.58	October 1960 - current	13.9	0.11	July 21, 1976	412	48.0	March 18, 1968
01176000	Quaboag River @ W. Brimfield	151	September 1912 - current	242	6.6	September 28, 1957	12,800	84.8	August 19, 1955
01177000	Chicopee River @ Indian Orchard	688	August 1928 - current	902	16.0	1929	45,200	65.7	September 21, 1938
01179500	Westfield River @ Knightville	168	August 1909 - current	325	1.1	April 2, 1965	6,600	40.7	March 21, 1945
01180500	Middle Branch Westfield River @ Goss Heights	52.6	July 1910 - current	104	0	October 20, 1910	1,360	25.9	April 25, 1972
01180800	Walker Brook near Becket Center	3.01	November 1962 - current	6.64	0.1	September 1, 1976	499	165.8	August 10, 1976
01181000	W. Branch Westfield River @ Huntington	93.7	September 1935 - current	188	3.3	August 9, 1955	26,100	278.5	August 19. 1955
01183000	Westfield Little River near Westfield	45.8	July 1905 - current	89.7	Flow controlled by water supply reservoirs				
01183450	Great Brook near Westfield	29.2	November 1972 - current	-	4.8	August 16, 1974	651	22.3	December 21, 1973
01183500	Westfield River near Westfield	497	June 1914 - current	913	40	December 28, 1914	70,300	141.4	August 19, 1955
01184000	Connecticut River @ Thompsonville, Connecticut	9,661	July 1928 - current	16,230	968	October 20, 1963	282,000	29.2	March 20, 1936
01185100	Fall River near Otis	16.5	August 1969 - current	39.1	0.68	June 20, 1973	422	25.6	July 2, 1972
01185500	W. Branch Farmington River near New Boston	92.0	May 1913 - current	181	2.4	August 20, 1957	34,300	372.8	August 19, 1955

1/ C.F.S. - cubic feet/second

2/ C.S.M. - cubic feet/second/square mile (of drainage area)

5.2 LAND USE

5.2A General

In the 20-year period between 1952 and 1972, significant land use changes occurred. Regionally, agricultural land decreased by slightly more than 66,000 acres or more than 27 percent of the 1952 agricultural land base. In 1952, 13.8 percent of the region was in agricultural use; by 1972, only 10.1 percent was in such use. On the other hand, urban land use expanded from 50,305 acres (2.8 percent) in 1952 to 125,692 acres (7.1 percent) in 1972, an increase of 75,387 acres (150 percent).

Table 5.2 summarizes the major changes in the county areas of the region.

TABLE 5.2 MAJOR LAND USE CHANGES, 1952-72

County Area[1/]	Agricultural land % change	Agricultural land acres	Forest land % change	Forest land acres	Urban land % change	Urban land acres
Berkshire	-39.5	- 3,362	-1.8	-2,591	97.1	4,350
Franklin	-16.8	-10,712	2.9	10,022	202.7	11,052
Hampshire	-24.3	-15,975	1.5	3,581	225.7	17,022
Hampden	-45.1	-24,903	-3.7	-8,899	107.1	31,858
Worcester	-22.1	-11,230	5.6	16,774	149.2	11,105
Connecticut River Region	-27.1	-66,182	1.5	18,887	149.8	75,387

SOURCE: MacConnell, et al.

1/ Only portions of Berkshire, Hampden, and Worcester Counties are in the Connecticut River Region and, therefore, the figures given are for the Connecticut River Region portion only.

Table 5.3 summarizes the land resource base in the region and the shares of each land use category to the total land base for each county area for the years 1952 and 1972. It is important to note that the "other" land use category is composed of the following subcategories as presented by MacConnell, et al.:

1. abandoned fields, most of which are reverting to forest or scrub brush;

2. abandoned fruit orchards;

3. pipeline, telephone, or powerline rights-of-way one hundred feet or more wide, maintained through wooded areas;

4. mining and waste disposal areas;

TABLE 5.3 LAND USE AND CHANGES BY ACRES

	Cropland	Pasture	Agricultural Land 1 & 2	Forest	Wetland	Water	Industrial/ Commercial	Residential	Institutional	Urban 6, 7, 8	Other	Total
Berkshire												
1952	2,780	5,732	8,512	145,669	2,168	2,024	11	114	6	131	7,084	165,588
1972	2,474	2,676	5,150	143,078	3,759	3,850	573	3,643	265	4,481	5,270	165,588
Change in acres	-306	-3,056	-3,362	-2,591	1,591	1,826	562	3,529	259	4,350	-1,814	
1952 share (%)	1.7	3.5	5.1	88.0	1.3	1.2	0.0	0.1	0.0	0.1	4.3	
1972 share (%)	1.5	1.6	3.1	86.4	2.3	2.3	0.3	2.2	0.2	2.7	3.2	
Change in % share	-0.2	-1.9	-2.0	-1.6	1.0	1.1	0.3	2.1	0.2	2.6	-1.1	
Franklin												
1952	23,588	40,020	63,608	348,848	4,242	14,164	1,019	3,986	448	5,453	29,140	465,455
1972	34,984	17,912	52,896	358,870	4,117	14,923	3,415	11,496	1,594	16,505	18,144	465,455
Change in acres	11,396	-22,108	-10,712	10,022	-123	759	2,396	7,510	1,146	11,052	-10,996	
1952 share (%)	5.1	8.6	13.7	74.9	0.9	3.0	0.2	0.9	0.1	1.2	6.3	
1972 share (%)	7.5	3.8	11.4	77.1	0.9	3.2	0.7	2.5	0.3	3.5	3.9	
Change in % share	2.4	-4.8	-2.3	2.2	0.0	0.2	0.5	1.6	0.2	2.3	-2.4	
Hampshire												
1952	45,548	20,071	65,619	240,376	4,626	11,612	736	5,871	935	7,542	19,182	348,957
1972	36,823	12,821	49,644	243,957	4,494	10,970	2,228	19,858	2,478	24,564	15,328	348,957
Change in acres	-8,725	-7,250	-15,975	3,581	-132	-642	1,492	13,987	1,543	17,022	-3,854	
1952 share (%)	13.1	5.8	18.8	68.9	1.3	3.3	0.2	1.7	0.3	2.2	5.5	
1972 share (%)	10.6	3.7	14.2	69.9	1.3	3.1	0.6	5.7	0.7	7.0	4.4	
Change in % share	-2.5	-2.1	-4.6	1.0	0.0	-0.2	0.4	4.0	0.4	4.8	-1.1	
Hampden												
1952	20,822	34,436	55,258	241,750	4,875	8,257	5,737	21,470	2,530	29,737	22,609	362,486
1972	20,092	10,263	30,355	232,851	2,965	9,576	12,805	44,369	4,421	61,595	25,144	362,486
Change in acres	-730	-24,173	-24,903	-8,899	-1,910	1,319	7,068	22,899	1,891	31,858	2,535	
1952 share (%)	5.7	9.5	15.2	66.7	1.3	2.3	1.6	5.9	0.7	8.2	6.2	
1972 share (%)	5.5	2.8	8.4	64.2	0.8	2.6	3.5	12.2	1.2	17.0	6.9	
Change in % share	-0.2	-6.7	-6.8	-2.5	-0.5	0.3	1.9	6.3	0.5	8.8	0.7	
Worcester												
1951	15,886	35,045	50,931	299,771	15,255	17,493	807	6,211	424	7,442	33,214	424,106
1971	20,983	18,718	39,701	316,545	11,241	18,757	2,478	14,742	1,327	18,547	19,315	424,106
Change in acres	5,097	-16,321	-11,230	16,774	-4,014	1,264	1,671	8,531	903	11,105	-13,899	
1951 share (%)	3.7	8.3	12.0	70.7	3.6	4.1	0.2	1.5	0.1	1.8	7.8	
1971 share (%)	4.9	4.4	9.4	74.6	2.7	4.4	0.6	3.5	0.3	4.4	4.6	
Change in % share	1.2	-3.9	-2.6	3.9	-0.9	0.3	0.4	2.0	0.2	2.6	-3.2	
Total Connecticut												
1951/2	108,624	135,304	243,928	1,276,414	31,166	53,550	8,310	37,652	4,343	50,305	111,229	1,766,592
1971/2	115,356	62,390	177,746	1,295,301	26,576	58,076	21,499	94,108	10,085	125,692	83,201	1,766,592
Change in acres	6,732	-72,914	-66,182	18,887	-4,590	4,526	13,189	56,456	5,742	75,387	-28,028	
1951/2 share (%)	6.1	7.7	13.8	72.3	1.8	3.0	0.5	2.1	0.2	2.8	6.3	
1971/2 share (%)	6.5	3.5	10.1	73.3	1.5	3.3	1.2	5.3	0.6	7.1	4.7	
Change in % share	0.4	-4.2	-3.7	1.0	-0.3	0.3	0.7	3.2	0.4	4.3	-1.6	

Source: MacConnell et al.

5. open or undeveloped land which is in the midst of, or adjacent to, urban areas; and

6. lands used for recreational purposes.

In 1972, there were 83,201 acres in the "other" land use category. This is a reduction of about 28,000 acres from the 1952 totals. When looking at the changes that have occurred during this 20-year period, care should be used. For example, increases in water acreages were due in part to the installation of water impoundments, but more accurate analysis of the 1972 aerial photos also explains much of the increase. In 1952, minimum size of plots interpreted was 10 acres; in 1972, the minimum size was decreased to 3 acres. Thus, certain ponds, rivers, and streams that were categorized as something other than water in 1952 were categorized as water in 1972.

The wetland category also poses a problem in that in 1952, beaver ponds, seasonally flooded flats and bogs were categorized as the dominant adjacent land use. In 1972, however, they were included within the wetland category. In both years of analysis, wooded swamps were included as forest land, since aerial photograph interpretation precluded a breakdown between these two categories. Thus, the wetland category should be considered as open wetlands. In summary, changes as listed in Tables 5.2 and 5.3 should not be taken on face value. The changes simply suggest the trends that have occurred in the land base for the 20-year period.

5.2B Agricultural Land

In terms of acreage changes, the most significant are agricultural and urban land. As Table 5.3 shows, total agricultural land decreased by 66,182 acres, yet cultivated land actually increased by 6,732 acres. An increase in excess of 11,000 acres in the Franklin County area accounts for most of this increase, with the Worcester County area contributing the rest (5,097) for a total increase of 16,493 acres. Most of this acreage increase was offset by losses in the Berkshire, Hampshire, and Hampden County areas. All county areas experienced declines in pasture because of diminishing livestock numbers, which explains the net decrease in agricultural land. It is interesting to note that the 1974 Census of Agriculture shows a decline in total cropland for both Franklin and Worcester County between 1969 and 1974. But in Worcester County, harvested cropland actually increased, albeit insignificantly.

There are a number of factors which appear to contribute to the continuing decrease in agricultural land:

1. Zoning bylaws--Most towns in the region have zoned agricultural land to permit low density residential use and, in some cases, industrial and commercial use. Most zoning regulations incorporate an implicit assumption that farming

is a residual or temporary use which will be replaced by nonagricultural uses. Zoning often is in direct opposition to the publicly professed land use objectives of preserving agricultural land.

Section 81 of Chapter 41, General Laws, stipulates that subdivision review is not required for any development which will be placed upon frontage along existing public roads. Although recently introduced legislation has a requirement that any development on more than two lots would require subdivision approval, the fact that there is no minimum time frame incorporated into the act somewhat diminishes its potential impact.[1/] The result is a large degree of strip development which creates the most expensive pattern for public services. Such development patterns also maximize the potential encroachment on agricultural land. For example, as development continues, farm operations taking place behind the strip may be subject to nuisance ordinances forced on the operator by the new residents who wield more political power.

2. Relative to competing agricultural areas, Massachusetts' climate provides a relatively short growing season. When that factor is amalgamated with the distribution of soil groups, size of holdings, and labor costs, a negative comparative advantage results. As Christensen pointed out, nearly three million acres were cleared and used for agriculture in 1860. Today, most of this land is now growing trees. But even if this former farmland was brought back into crop production, the resulting food costs would be higher than they are now because of the expense of working the land and the relatively low yields:

   > "Plowing and tilling an acre of stony land has a much higher cost than plowing an acre of nonstony land and, when this extra cost is combined with lower yields, the resulting food produce has a high production cost per unit of yield."[2/]

3. A third factor that helps explain the loss of agricultural land is the fact that there are very few storage facilities in the state; thus, the advantages of bulk shipping from the food and feed crop exporting areas cannot be gained. As a result, the unit cost of transporting the necessary productive inputs are high and, consequently, the cost of raising livestock and crops are higher than in those areas which have adequate storage facilities.

   For example, in 1945, poultry production was the most important source of farm income in Massachusetts (38.1 percent) as[3/] compared to 1974 when it amounted to approximately 13 percent of the value of agricultural production.[4/] This decline was

brought about by the vast expansion of poultry enterprises in the DelMarVa Peninsula and areas further south. The climatic difference is such that corn and soybeans, the major feed ingredients, grow prolifically in these southern areas. And when there are inadequacies in cropland area, the presence of large storage facilities permit the bulk transportation of feed at minimal costs. As a result, the poultry areas of the south can produce chickens at a lower cost, while equalling or exceeding the quality of the Massachusetts product.

4. A fourth reason which explains the loss of agricultural land is two-fold: higher transportation rates and a lack of a coordinated marketing system. As Platt, et al. diagrammed, Franklin and Hampshire Counties are the major agricultural areas in the state.[5/] Much of this area which borders the Connecticut River is in field corn, tobacco, and vegetable crop production. But the lack of consistent product quality coupled with a sporadic supply schedule has precluded the development of vegetable processing industry or a well coordinated fresh-market system. As a result, other regions in the country, namely Florida and California, with their longer growing seasons, crop varieties, and modern processing plants, supply a great deal of the fresh and processed vegetable products to Massachusetts.

As a step in curbing the loss of agricultural land, the Massachusetts General Court enacted Chapter 61A in 1973, an act providing for the assessment of agricultural land at a value based upon its agricultural or horticultural uses. Although a rigorous assessment of the impact of this act has not been undertaken, the general consensus is that it has been of minimal effectiveness in curbing the loss of agricultural land. The primary explanation for this result is that there was defacto agricultural assessment prior to the passage of the act. As Barlowe and Atter stated:

> "How far use-value assessment programs can go in protecting agricultural and open space land depends largely on the emphasis given to the current use-protection objective.
>
> "Landowners have a natural economic incentive for favoring taxing arrangements that provide them with benefits and still leave them with the option of developing or selling their lands. A protection policy, in contrast, calls for tight declassification procedures that discourage or prevent withdrawals once lands have been accepted for (agricultural assessment) classification.

"These two objectives are in conflict. Programs that emphasize the first objective provide little protection for existing land uses while those that emphasize the protection goal offer little incentive for owner participation. Considerable emphasis has been given to protectionist goals in several laws enacted in the past decade, but even the most restrictive of these involves elements of compromise between the two objectives.

"Recognition of these factors prompts the conclusion that by itself, use-value assessment cannot provide more than a partial answer to the farmland and open space preservation problem. Its chief merit lies in the role it can play in buying time, particularly in semirural areas, for state and local governments to seek and enact supplemental programs to protect agricultural and open space lands." 6/

Defacto agricultural assessment has precluded the agricultural assessment act from being an effective means of preserving agricultural and horticultural lands. However, the situation has recently changed, since each city and town must assess property values at 100 percent of market value. Such an assessment would preclude defacto assessments and, therefore, the potential effectiveness of the agricultural assessment act may increase substantially.

To further the potential of agricultural preservation, the General Court enacted a development rights bill which enables cities and towns to purchase the development rights to agricultural land. In November 1977, an additional bill was passed which provides $5 million for acquisition of development rights on agricultural land.

The River's Reach, a Unified Program for Flood Plain Management in the Connecticut River Basin, published by the NERBC in December 1976, recommends the preservation of natural flood storage, and the prevention of urban development in flood hazard areas. More importantly, for our objective to preserve agricultural land, this report recommends the maintenance of agriculture as a prime open space flood plain land use.

The effectiveness of a development rights program may be limited because land is merely one of many productive inputs. In a recent investigation trying to explain the loss of agricultural land, the variables having to do with increased population growth, increasing taxes, and increased urbanization were insignificant in explaining the loss. This strongly suggests that the agricultural demise results from low net income to the agricultural community. To the extent that the development rights program supplies additional capital to the farmers and, to the extent that such capital is invested in cost reducing measures, then the development rights program may have a positive impact.

5.2C Agricultural Land Study

The U.S. Department of Agriculture is concerned about any action that tends to impair the productive capacity of American agriculture. The continuing loss of farmland in the region is such an action. Nationwide, the Soil Conservation Service has a Land Inventory and Monitoring Program to inventory and keep current an assessment of prime farmland and unique farmland acreage. Farmlands that are of statewide or local importance for producing crops are also identified. The nation needs to know the extent and location of the best land for producing food, feed, fiber, and forage.

The first phase of the farmland inventory will be conducted in those counties which have published soil surveys available. In the Connecticut River Region, the soil surveys and a published report have been completed for Franklin County. Results of the nationwide Land Inventory and Monitoring Program are not expected in the Connecticut River Region until the early 1980s.

Three categories of farmland are being inventoried:

1. Prime Farmland--Prime farmland is land best suited for producing food, feed, forage, and fiber; and also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban, built-up land, or water). It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern farming methods.

2. Unique farmland--Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to produce sustained high quality and/or high yields of a specific crop when treated and managed according to modern farming methods. Examples of such crops in Massachusetts are cranberries and fruit orchards.

   Unique farmland has the following characteristics:

   a. It is used for a specific high-value food or fiber crop.

   b. It has a moisture supply that is adequate for the specific crop; the supply is from stored moisture, precipitation, or a developed irrigation system.

   c. It combines favorable factors of soil quality, growing season, temperature, humidity, air drainage, elevation, aspect, or other conditions such as nearness to market, that favor the growth of a specific food or fiber crop.

3. Additional Farmland of Statewide and Local Importance--This is land, in addition to prime and unique farmland, that is of statewide and local importance for the production of food, feed, fiber, and forage crops. Criteria for defining and delineating this land are to be determined by state and local personnel familiar with the specific needs of the region. These soils include some of those commonly utilized for pasture and hay.

To illustrate the dramatic irreversible loss of farmland soil in the Connecticut River Region, the Massachusetts Water Resources Study has analyzed data for 15 towns. Basic data was prepared in a manner which can make it useful to a variety of state and local agencies in their efforts to protect existing farmland.

Towns were selected to represent a geographic distribution in the region. A prerequisite for inclusion of a town was the availability of a published special soils report for the community. Communities selected are shown on Figure 5.6.

Franklin County towns were omitted from this study to avoid duplicating the results derived from the Land Inventory and Monitoring Program.

A base map for the community was prepared at scale 1:24,000 (1 inch = 2,000 feet), using the U.S. Geological Survey topographic maps. Detailed soils data was adjusted to the base map, and a transparent mylar overlay of the detailed soils map was prepared. Another mylar overlay was constructed which indicated all prime farmland and farmland of state and local importance.

Using a transparent copy of this farmland soils overlay, land use data was added using the 1971-1972 Massachusetts Map Down maps. Existing farming was mapped wherever it occurred in the town. In addition, land uses were mapped for all areas of farmland soils.

The data contained in this combined farmland soils-land use overlay was measured and summarized. Results are presented in Tables 5.4 through 5.8. Some interesting conclusions can be drawn from this study of farmland in the region.

First, agricultural land use averages 15 percent for the 15 towns sampled. Agricultural use ranges from 29 percent of the area of Amherst to only 4.6 percent for the town of Winchendon.

Towns sampled were selected on the basis of prime farmland acreage. In these towns, prime farmland soils on the average constitute about 18 percent of the town area.

In the sample towns, approximately 40 percent of the prime farmland soils is being used for agriculture, while approximately 20 percent

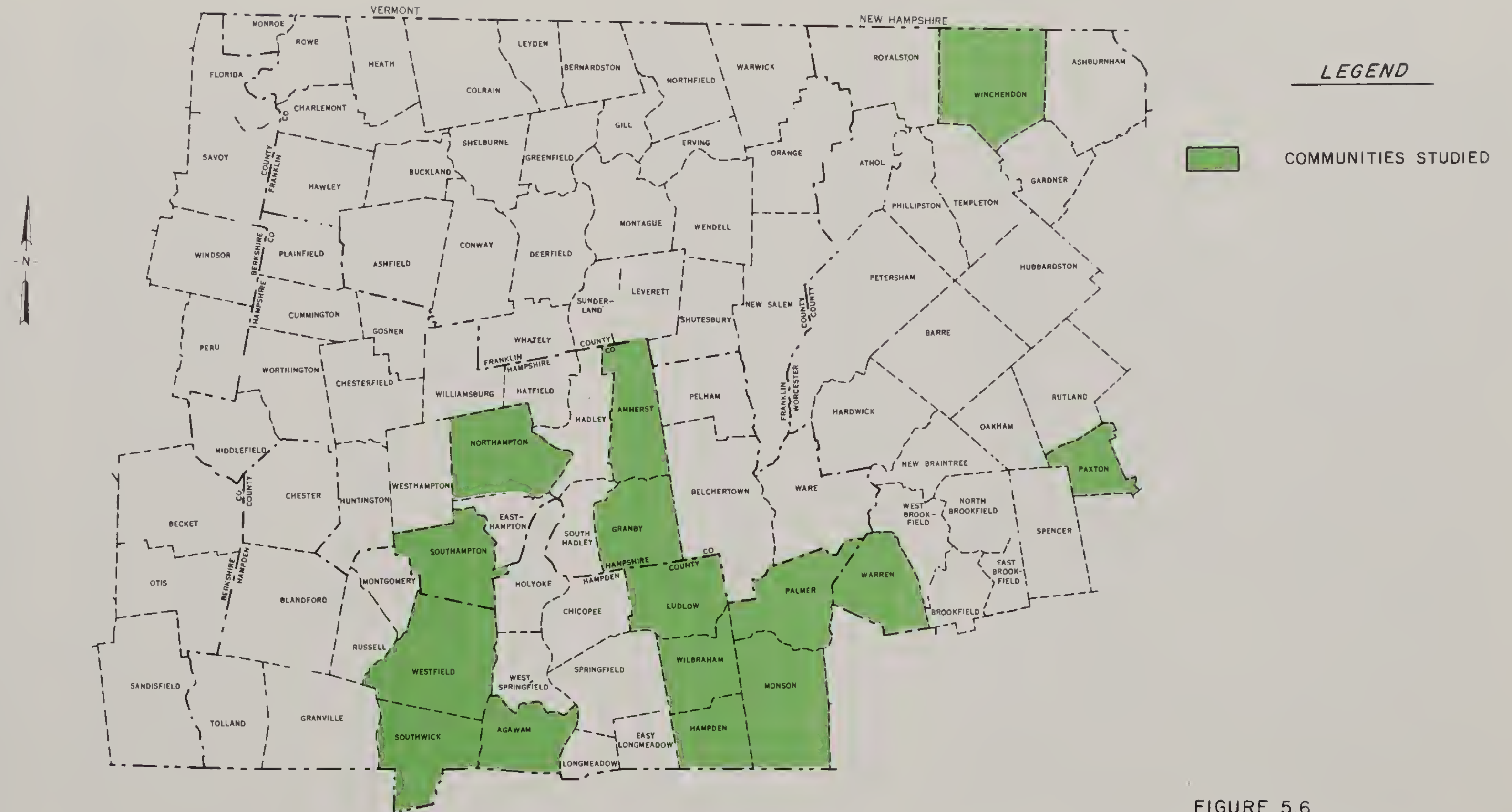


FIGURE 5.6

COMMUNITIES STUDIED IN AGRICULTURAL LAND STUDY

CONNECTICUT RIVER REGION
MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TABLE 5.4 EXISTING FARMLAND

	Cropland	Pasture	Orchard	Total
	Acres (Percent of Town Area)			
Agawam	3,834 (24.5)	271 (1.7)	2.5 (0.2)	4,130 (26.4)
Amherst	2,952 (16.7)	1,822 (10.3)	343 (1.9)	5,117 (29.0)
Granby	2,794 (15.6)	668 (3.7)	14 (0.1)	3,476 (19.4)
Hampden	495 (4.0)	695 (5.6)	47 (0.4)	1,237 (10.0)
Ludlow	713 (4.0)	895 (5.0)	23 (0.1)	1,631 (9.0)
Monson	966 (3.3)	1,312 (4.5)	82 (0.3)	2,360 (8.1)
Northampton	3,431 (15.1)	357 (1.6)	25 (0.1)	3,813 (16.8)
Palmer	962 (4.9)	745 (3.8)	44 (0.2)	1,751 (8.9)
Paxton	628 (6.3)	492 (94.9)	0 0	1,120 (11.2)
Southampton	1,995 (10.5)	1,102 (5.8)	19 (0.1)	3,116 (16.5)
Southwick	2,919 (14.6)	1,982 (9.9)	11 (0.1)	4,912 (24.6)
Warren	1,163 (6.6)	1,214 (6.9)	71 (0.4)	2,448 (13.9)
Westfield	3,427 (11.5)	1,654 (5.5)	77 (0.3)	5,158 (17.3)
Wilbraham	551 (3.9)	594 (4.2)	146 (1.0)	1,291 (9.0)
Winchendon	634 (2.2)	660 (2.3)	0 0	1,294 (4.6)

TABLE 5.5 PRIME FARMLAND SOILS

Community	Cropland	Pasture	Orchard	Land Use Forest	Available	Urban	Total[1/]
	Acres Percent of Prime Soils in this Land Use						
Agawam	1,980 (36.1)	92 (1.7)	23 (0.4)	1,644 (30.0)	344 (6.3)	1,401 (25.5)	5,484 (35.1)
Amherst	1,780 (27.6)	1,120 (17.3)	125 (1.9)	1,607 (24.8)	675 (10.4)	1,164 (18.0)	6,471 (36.6)
Granby	1,731 (40.7)	217 (5.1)	0 0	1,455 (34.2)	331 (7.8)	520 (12.2)	4,254 (23.7)
Hampden	173 (8.6)	306 (15.1)	7 (0.3)	937 (46.4)	196 (9.7)	401 (19.9)	2,020 (16.2)
Ludlow	323 (10.0)	342 (10.6)	6 (0.2)	927 (28.6)	334 (10.3)	1,306 (40.3)	3,238 (18.0)
Monson	390 (18.3)	239 (11.2)	7 (0.3)	1,088 (51.1)	241 (11.3)	163 (7.7)	2,128 (7.3)
Northampton	2,305 (55.0)	62 (1.5)	7 (0.2)	798 (19.1)	277 (6.6)	739 (17.6)	4,188 (18.5)
Palmer	246 (15.5)	195 (12.3)	0 0	661 (41.6)	227 (14.3)	261 (16.4)	1,590 (8.1)
Paxton	342 (23.2)	192 (13.0)	0 0	570 (38.7)	63 (4.3)	304 (20.7)	1,471 (14.8)
Southampton	857 (28.6)	360 (12.0)	10 0	1,248 (41.6)	222 (7.4)	311 (10.4)	2,998 (15.9)
Southwick	1,023 (30.9)	808 (24.4)	0 0	932 (28.1)	212 (6.4)	336 (10.1)	3,311 (16.6)
Warren	402 (40.8)	187 (19.2)	17 (1.7)	202 (20.5)	149 (15.1)	25 (2.5)	984 (5.6)
Westfield	1,590 (31.8)	570 (11.4)	14 (0.3)	1,488 (29.7)	301 (6.0)	1,039 (20.8)	5,002 (16.8)
Wilbraham	328 (9.4)	254 (7.3)	21 (0.6)	1,459 (42.0)	273 (7.8)	1,142 (32.8)	3,477 (24.4)
Winchendon	366 (16.5)	327 (14.8)	0 0	736 (33.3)	164 (7.4)	619 (27.9)	2,212 (7.8)

1/ Percent of town with prime farmland soils.

SCS PHOTO

New residential housing is growing in the upper end of this cornfield on Prime Farmland soil.

TABLE 5.6 SOILS OF STATE AND LOCAL IMPORTANCE FOR FARMING

Community	Cropland	Pasture	Orchard	Forest	Available	Urban	Total 1/
	Acres (Percent of Soils of State and Local Importance in This Use)						
Agawam	442 (24.7)	53 (3.0)	1 (0.1)	631 (35.2)	143 (8.0)	522 (29.1)	1,792 (11.5)
Amherst	573 (17.5)	332 (10.1)	157 (4.8)	1,459 (44.6)	149 (4.5)	605 (18.5)	3,275 (18.5)
Granby	549 (17.8)	143 (4.6)	5 (0.2)	1,699 (55.2)	265 (8.6)	417 (13.5)	3,078 (17.2)
Hampden	211 (11.1)	185 (9.7)	18 (0.9)	831 (43.8)	196 (10.3)	458 (24.1)	1,899 (15.3)
Ludlow	178 (7.2)	201 (8.1)	11 (0.4)	976 (39.2)	199 (8.0)	924 (37.1)	2,489 (13.8)
Monson	344 (5.9)	507 (8.8)	46 (0.8)	3,563 (61.6)	595 (10.3)	731 (12.6)	5,786 (23.2)
Northampton	522 (11.9)	145 (3.3)	7 (0.2)	1,956 (44.4)	191 (4.3)	1,582 (35.9)	4,403 (19.44)
Palmer	420 (9.8)	236 (5.5)	0 0	1,833 (42.8)	484 (11.3)	1,312 (30.6)	4,285 (21.8)
Paxton	232 (8.7)	219 (8.2)	0 0	1,781 (66.7)	135 (5.1)	303 (11.3)	2,670 (26.9)
Southampton	782 (15.4)	424 (8.4)	3 (0.1)	3,058 (60.3)	253 (5.0)	551 (10.9)	5,071 (26.8)
Southwick	1,453 (19.5)	706 (9.5)	9 (0.1)	3,616 (48.5)	487 (6.5)	1,181 (15.8)	7,452 (37.4)
Warren	436 (18.9)	414 (17.9)	32 (1.4)	861 (37.3)	316 (13.7)	247 (10.7)	2,306 (13.1)
Westfield	1,205 (11.8)	580 (5.7)	20 (0.2)	5,363 (52.3)	464 (4.5)	2,612 (25.5)	10,247 (34.3)
Wilbraham	94 (3.7)	102 (4.0)	57 (2.2)	1,423 (56.3)	180 (7.1)	670 (26.5)	2,526 (17.7)
Winchendon	138 (3.2)	203 (4.6)	0 0	3,446 (78.9)	171 (3.9)	407 (9.3)	4,365 (15.5)

1/ Percent of the town with soils of state and local importance for farming.

TABLE 5.7 PRIME FARMLAND SOILS AND SOILS OF STATE AND LOCAL IMPORTANCE FOR FARMING

Community	Cropland	Pasture	Orchard	Land Use Forest	Available	Urban	Total 1/
	Acres (Percent of Prime Farmland Soils and Soils of State and Local Importance in This Land Use)						
Agawam	2,442 (33.6)	145 (2.0)	24 (0.3)	2,275 (31.3)	487 (6.7)	1,923 (26.4)	7,276 (46.6)
Amherst	2,353 (24.1)	1,452 (14.9)	282 (2.9)	3,066 (31.5)	679 (7.0)	1,769 (18.2)	9,746 (55.2)
Granby	2,280 (31.1)	360 (4.9)	5 (0.1)	3,154 (43.0)	596 (8.1)	937 (12.8)	7,332 (40.9)
Hampden	384 (9.8)	491 (12.5)	25 (0.6)	1,768 (45.1)	392 (10.0)	859 (21.9)	3,919 (31.5)
Ludlow	501 (8.7)	543 (9.5)	17 (0.3)	1,903 (33.2)	533 (9.3)	2,230 (38.9)	5,727 (31.8)
Monson	734 (9.3)	746 (9.4)	53 (0.7)	4,651 (58.8)	836 (10.6)	894 (11.3)	7,914 (30.5)
Northampton	2,827 (32.9)	207 (2.4)	14 (0.2)	2,754 (32.1)	468 (5.4)	2,321 (27.0)	8,591 (37.9)
Palmer	666 (8.9)	431 (5.8)	0 0	2,494 (33.5)	711 (9.5)	1,573 (21.1)	7,448 (29.9)
Paxton	574 (13.9)	411 (10.0)	0 0	2,351 (56.8)	178 (4.7)	607 (14.7)	4,141 (41.8)
Southampton	1,639 (20.3)	784 (9.7)	3 0	4,306 (53.4)	475 (5.9)	862 (10.7)	8,069 (42.7)
Southwick	2,476 (23.9)	1,514 (14.1)	9 (0.1)	4,548 (42.3)	690 (6.4)	1,517 (14.1)	10,763 (54.0)
Warren	838 (25.5)	603 (18.3)	49 (1.5)	1,063 (32.3)	465 (14.1)	272 (8.3)	3,290 (18.7)
Westfield	2,795 (18.3)	1,150 (7.5)	34 (0.2)	6,851 (44.9)	765 (5.0)	3,651 (23.9)	15,249 (51.7)
Wilbraham	422 (7.0)	356 (5.9)	78 (1.3)	2,882 (48.0)	453 (7.5)	1,812 (30.2)	6,003 (42.1)
Winchendon	504 (7.7)	530 (8.1)	0 0	4,182 (63.6)	335 (5.1)	1,026 (15.6)	6,577 (23.3)

1/ Percent of the town with prime farmland soils and soils of state and local importance for farming.

TABLE 5.8 "OTHER"[1/] SOILS BEING FARMED

Community	Cropland (acres)	Pasture (acres)	Orchard (acres)	Total (acres)	Percent of Existing Farmland Located on "Other" Soils
Agawam	1,412	126	1	1,539	37.3
Amherst	599	370	61	1,030	20.1
Granby	514	308	9	831	23.9
Hampden	111	204	22	337	27.2
Ludlow	212	352	6	570	34.9
Monson	232	566	29	827	35.0
Northampton	604	150	11	765	20.1
Palmer	296	314	44	654	37.4
Paxton	54	81	0	135	12.1
Southampton	356	318	16	690	22.1
Southwick	443	468	2	913	18.6
Warren	325	611	22	958	39.1
Westfield	632	504	40	1,176	22.8
Wilbraham	129	238	68	435	33.7
Winchendon	130	130	0	260	20.1

1/ "Other" soils are all soils except those classified as prime farmland soils or soils of state and local importance for farming.

of the prime farmland soils is urban. Forest land accounts for 32 percent of the prime farmland soils in these towns.

For soils of state and local importance, conclusions are quite different:

a. These soils average about 21 percent of the town area.

b. Twenty percent of the land containing these soils is being used for agriculture and for urban use.

c. Forest land represents the greatest land use of these soils, approximately 53 percent of the total area.

Approximately one-fourth of the existing farmland is located on soils other than prime farmland or soils of state and local importance.

The implications for potential erosion problems on the large percentage of farmland located on "other" soils cannot be ignored. These soils usually require good conservation practices to avoid excessive erosion losses. Naturally, these conservation practices add to the "cost of doing business" for the farmer.

John Foster of the Department of Food and Resource Economics, University of Massachusetts, undertook a study similar to that which has been described above. In Foster's study, a sample of 26 towns was examined to determine the changes that occurred on agricultural land between 1951 and 1971.[7/] His findings are very similar to those enumerated above: 42 percent of the better agriculture soils are in forest land because of previous reversion, and urban land is found on 12 percent of these soils. His sample of 26 towns differed somewhat in that he chose only those towns with large agricultural areas relative to urban areas. As a result, his findings showed that in 1971, intensive agriculture (tilled land, orchard and nursery uses) was found on 25 percent or 119,000 acres of the better agricultural soils in the state.

Foster also developed a data base to show how agricultural land uses changed in the state between 1951 and 1971. He delineated the 1971 acres of tilled land among three soil productivity groups: "best", "moderately good", and "poor". Approximately half of the state's tilled land was found on soils classified as "best" for agriculture, and another third was found on "moderately good" soils. Between 1951 and 1971, 5,900 acres per year were lost from tilled agricultural land to nonagricultural uses. Of this amount, 1,700 acres were classified as "best" agricultural land and went into the following uses: 400 became abandoned, 900 moved into urban uses, 200 became forested, and another 200 went into other uses (primarily recreation, but also includes mining, waste disposal, and wetlands). Another 1,500 acres were classified as "moderately good" agricultural soil and went into the following uses: 400 became abandoned, 700 went to urban uses, 200 went to forest uses, and another 200 went to other uses. A total of

56,000 acres went from tilled agricultural land of all types to urban uses between 1951 and 1971, and 32,000 acres of that amount were "best" and "moderately good" agricultural land. In summary, almost half of the agricultural land that went into nonagricultural uses was relatively good productive agricultural land. It must also be recognized that there were 84,000 acres of best and moderate agricultural land that were abandoned between 1951 and 1971. This acreage, unless committed to another use, will also revert to forest land.

To assist communities in assessing the status of their agricultural resource base, the Soil Conservation Service can provide a limited number of transparent overlays of the data compiled for this agricultural land study. The map data can be helpful in visualizing the extent of agricultural soils, existing agricultural enterprise, and in predicting future agricultural impacts of urban growth. The maps should be useful to planning boards, zoning boards of appeal, and conservation commissions. They are especially useful to communities about to embark on measures designed to protect their agricultural resources.

To illustrate the types of data available and the scope of information contained therein, a map has been prepared for the town of Granby and printed as Figure 5.7 of this report. This map is the combination of three overlays and is intended to publicize the data available in the 15-communities which were sampled. Several other combinations or permutations of the basic overlays are possible, depending on the needs of the community. Interested town officials should direct their requests to the local conservation district.

5.2D Forest Land

Forest land provides economic, environmental, and social benefits in the forms of wood products, water, wildlife, forage, and recreation. The owner of land can produce wood products, recreation and forage, and within the owner's prerogatives and land capabilities determine the product mix of these benefits. The owner can enhance water and wildlife benefits but cannot directly produce these for water and wildlife are not confined to land ownership boundaries.

The ownership of forest land, the number of acres owned, and the reasons for owning forest land provide data useful to make inferences on the forest land resource base and for wood product production. With the exception of forage, all forest land is available for the production of the other benefits.

Approximately 83 percent of the forest land is in private ownership, which includes individuals, partnerships, and corporations. Seventeen percent of the forest land is in public ownership, which includes local, state, and federal public or quasi-public governments. Public

lands are generally managed to produce multiple benefits. Private lands may or may not be managed.

Private commercial forest land in the region is in many sized tracts. An estimated 20 percent of the owners own nine or fewer acres and control two percent of the total acres. Seventy-two percent of the owners own 49 or fewer acres and control 28 percent of the total acres. Twenty-eight percent of the owners own 50 or more acres and control 72 percent of the total acres (Table 5.9).

TABLE 5.9 OWNERSHIP OF COMMERICAL FOREST LAND BY SIZE CLASS, NUMBER OF OWNERS, AND ACRES OWNED[1/]

SIZE CLASS (Acres)	NUMBER OF OWNERS (Percent)	ACRES OWNED (Percent)
1-9	20	2
10-19	32	9
20-49	20	17
50-99	13	20
100-199	10	24
200-499	4	18
500+	1	10

1/ Derived from unpublished data on forest land ownership in Massachusetts, Northeastern Forest Experimental Station, Upper Darby, Pennsylvania.

Private commercial forest landowners in Massachusetts own land for various reasons. These include land investment, recreation, timber production, and part of residence. A study by Kingsley[8/] of commercial forest landowners in Massachusetts shows that four percent of the owners own land for timber production. This group of owners owns ten percent of the acreage. Fifty-seven percent of the owners look upon forest land as an investment or as part of their residence. These groups own 45 percent of the commercial forest land (Table 5.10).

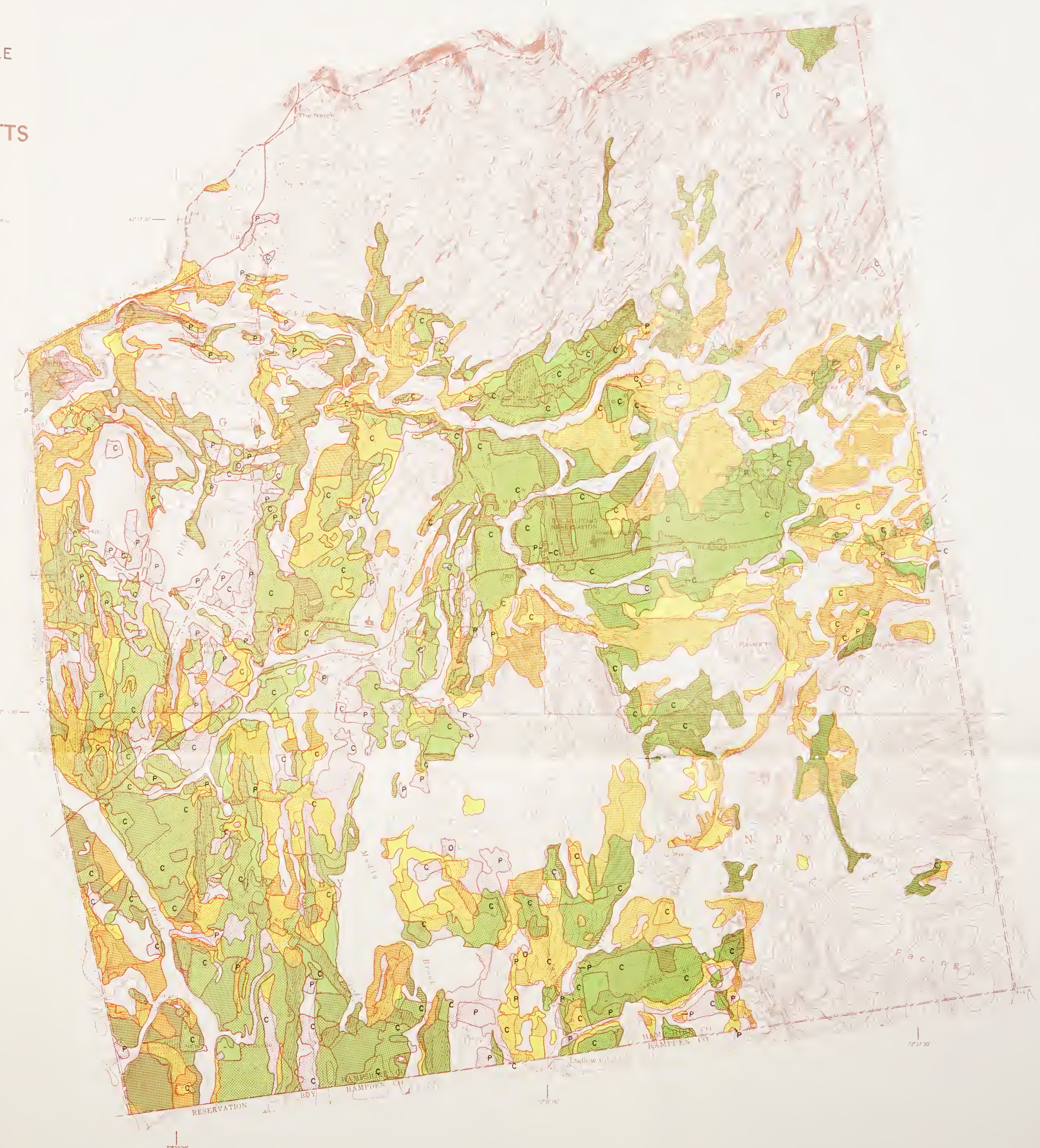
Although timber production is only a minor reason for owning land, this does not preclude the owners' cutting timber. Kingsley estimates that 56 percent of the private commercial forest land in Massachusetts, Connecticut, and Rhode Island is available for cutting wood products. Based on this inference and drawing a conclusion from the total forest land acreage, an estimated 723,000 acres are potentially available for the cutting of wood products.

FIGURE 5.7

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

AGRICULTURAL LAND MAPPING EXAMPLE

TOWN OF GRANBY
HAMPSHIRE COUNTY, MASSACHUSETTS



FARM LAND SOILS
LEGEND

- PRIME FARM LAND
- LAND OF STATE AND LOCAL IMPORTANCE FOR FARMING

LAND USE ON FARM LAND SOILS & EXISTING FARM LAND
LEGEND

AVAILABLE OPEN LAND	O ORCHARD
C CROPLAND	P PASTURE
FOREST	UNAVAILABLE (URBAN AND OTHER COMMITTED LANDS)

NOTE: LAND USES FOREST, AVAILABLE AND UNAVAILABLE SHOWN ONLY ON PRIME FARMLAND AND LAND OF STATE AND LOCAL IMPORTANCE FOR FARMING

BASE SOURCE U.S.G.S. Topo Quad Sheets 1:24 000

TABLE 5.10 REASONS FOR OWNING FOREST LAND BY NUMBER OF OWNERS AND ACREAGE OWNED MASSACHUSETTS

REASON	NUMBER OF OWNERS (Percent)	ACREAGE OWNED (Percent)
Land Investment	16	19
Recreation	16	21
Timber Production	4	10
General Farm Use	9	12
Part of Residence	41	26
Other	14	12
Total	100	100

SOURCE: Kingsley, op. cit.

SCS PHOTO

Timber Stand Improvement in Hampshire County.

5.3 FLOODING

Major floods in the region have been the result of hurricane storms with intense rainfall over a two- or three-day period or late winter rains which fell on frozen ground or snow, resulting in relatively large runoff volumes. On the main stem of the Connecticut River, the March 17-20, 1936 flood is the largest flood of record. For most of the more northern major tributaries such as the Deerfield and Millers Rivers, the hurricane storm of September 1938 produced the largest flood of record. On the major tributaries in the southern portion of the region, the Hurricane Diane storm of August 17-20, 1955 produced the largest recorded flows. This storm which deposited 3 to 19 inches of rainfall occurred one week after Hurricane Connie which deposited 3 to 6 inches. Thus, when Hurricane Diane occurred, the ground was saturated and streamflows were above normal.

The isohyetal map (Figure 5.8) shows the precipitation which occurred during the Hurricane Diane storm of August 17-20, 1955. This information was taken from U.S. Weather Bureau, Technical Paper No. 26, Hurricane Rains and Floods of August 1955, Carolinas to New England.

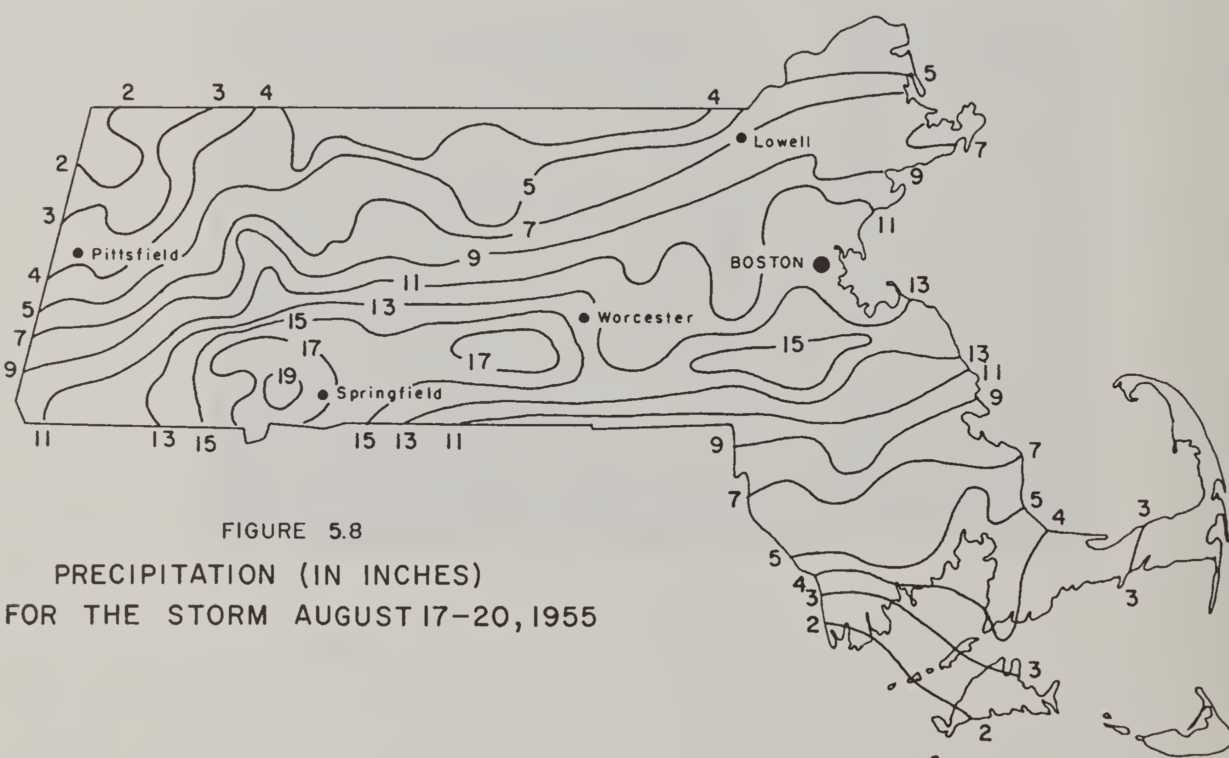


FIGURE 5.8

PRECIPITATION (IN INCHES)
FOR THE STORM AUGUST 17-20, 1955

In December 1976, the New England River Basins Commission published The River's Reach, A Unified Program for Flood Plain Management in the Connecticut River Basin. This is the final report of the Connecticut River Supplemental Study and amends the NERBC 1980 Connecticut River Basin Plan. The supplemental study was a three-year flood management study which concentrated on the main stem Connecticut River and three selected upstream watersheds. The main stem study was a reevaluation of the need for seven additional major flood control reservoirs, as proposed by the Corps of Engineers in the October 1970 Connecticut River Comprehensive Study. The three selected upstream watersheds analyzed included one Massachusetts watershed, the Mill River (Northampton), which is listed as subwatershed CV-22 in this report. Analyses of the three selected watersheds consisted of a reevaluation of existing flood problems and development of alternative flood management plans. These plans considered structural solutions, and nonstructural solutions including floodproofing, relocation of buildings on the flood plain, flood warning systems, land use controls, and flood insurance.

The main conclusions of the supplemental study are:

1. The seven additional major flood control dams should be dropped from further consideration.

2. Emphasize the use of nonstructural measures to modify susceptibility to flooding in a unified program for the basin.

3. Within the context of a nonstructural regional strategy, the use of structural measures in specific local situations may be called for.

4. For six major cities of the four state Connecticut River Basin, i.e., Hartford, Connecticut, Springfield, Massachusetts, etc., consider raising flood protection dikes if economically justified.[9/]

In line with these major conclusions, other recommendations are:

1. Improve the flood warning and evacuation system.

2. Preserve upstream natural valley storage and, in particular, maintain agriculture as a prime open space flood plain use.

3. Implement the National Flood Insurance Program.

4. Guide growth away from flood hazard areas.

5. Relocate buildings from extreme flood hazard areas.

In the flooding analyses prepared by the Soil Conservation Service for this study, it was decided that the main stem of the Connecticut River would not be investigated because the Corps of Engineers, New England River Basins Commission, and others have developed and presented information on flooding problems and solutions on the main stem in the supplemental study report mentioned above.

Field investigations made by the Soil Conservation Service indicate that average annual flood damage in the region, excluding the main stem of the Connecticut River, exceeds $1,800,000, and that a 100-year frequency flood would cause damage in excess of $30 million. Average annual damages and damages expected from a 100-year flood in each of the region's subwatersheds are summarized in Table 5.11 and Figure 5.9.

Historically, many industries were located on the flood plain because water was necessary for plant operations. The alternative of developing above the flood plains was more costly, since it meant substituting more expensive methods if water was needed for power, plant waste discharge, or as a coolant. Railroad, road, and residential building upon flood plains also resulted from the lower comparative costs. In addition, much residential development was stimulated by the existing industrial flood plain development, i.e., housing for factory workers was often located in close proximity to employment.

In flood plain development, one significant cost determinant was often excluded from the decisionmaking process--this being the cost of flood damage. In some instances, the flood hazard was not recognized. In others, the hazard was recognized, but the severity was misjudged. In still other cases, federal disaster assistance after the flood encouraged rehabilitation of flood damaged property in the same location.

The filling of wetlands and encroachment on the flood plains for development not only endangers the developed area itself, but compounds problems downstream. As a wetland is filled, its ability to reduce flood peaks by storing water for later release is diminished. Filling or blocking the flood plains also increases peak flows downstream but, even more important, it causes greater depths of flow and higher velocities for any given flood. In addition, the conversion of marshland and vegetation to rooftops and paved parking lots results in an increased volume of runoff for an equal amount of rainfall.

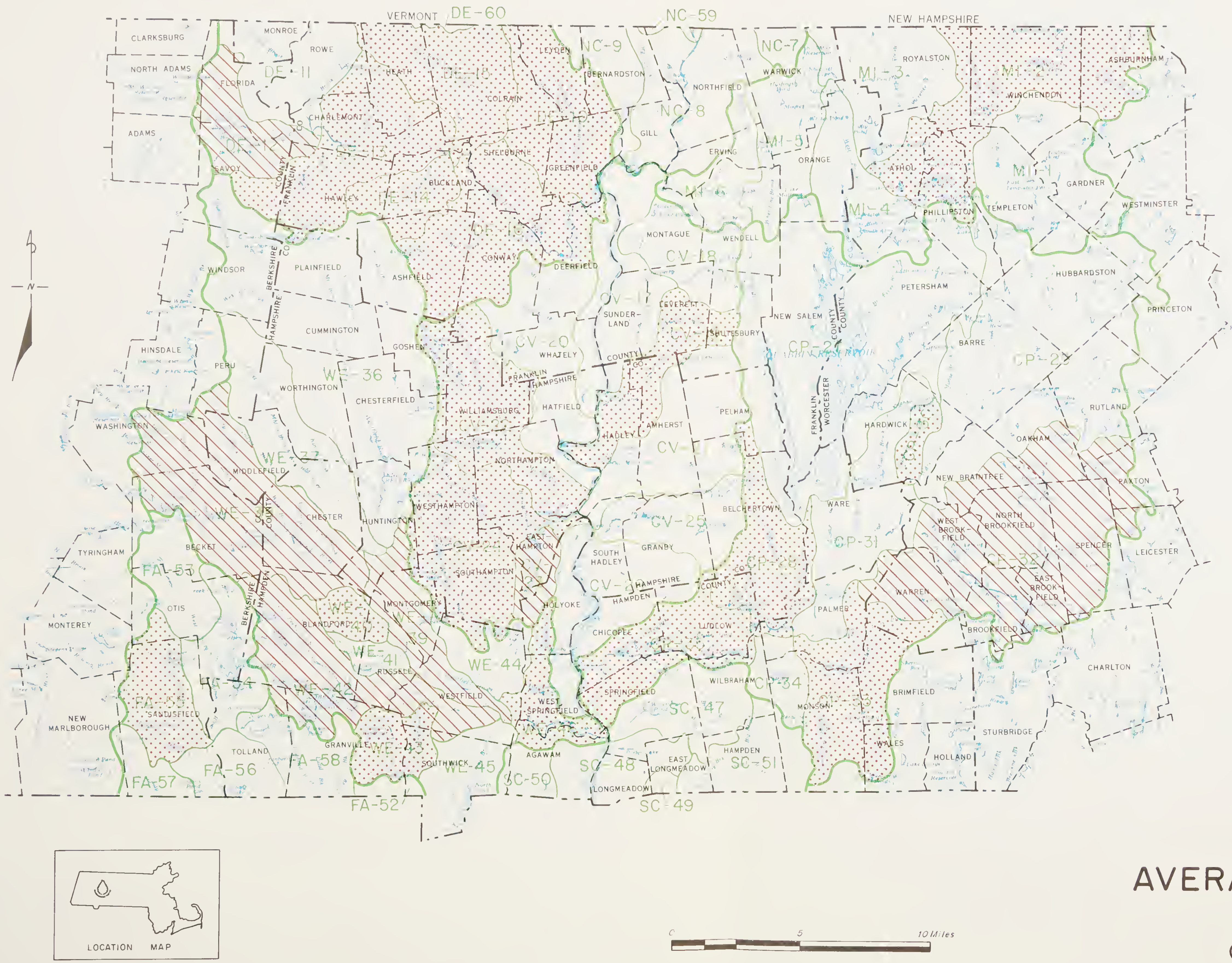


FIGURE 5.9

AVERAGE ANNUAL FLOOD DAMAGE

CONNECTICUT RIVER REGION

MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TABLE 5.11 PRESENT FLOOD DAMAGES[1/]

Subwatershed	100-Year Flood Damage	Average Annual Damage
-Deerfield River Watershed-		
DE-10 (Green River)	$ 318,600	$ 7,600
DE-11 (Deerfield River)		2/
DE-12 (Cold River)	2,754,000	137,000
DE-13 (Chickley River)	300,000	15,000
DE-14 (Clesson Brook)	255,000	12,200
DE-15 (North River)	517,900	20,000
DE-16 (Deerfield River)	140,000	11,700
DE-60 (North River - East Branch)		2/
-Northern Connecticut River Valley Watershed-		
NC-7 (Ashuelot River)		2/
NC-8 (Pauchaug Brook)		2/
NC-9 (Falls River)		2/
NC-59 (Broad Brook)		2/
-Millers River Watershed-		
MI-1 (Otter River)		2/
MI-2 (Millers River)	1,350,000	25,800
MI-3 (Tully River)		2/
MI-4 (Millers River)		2/
MI-5 (Moss Brook)		2/
MI-6 (Keyup Brook)		2/
-Westfield River Watershed-		
WE-36 (Westfield River)		2/
WE-37 (Westfield River - Middle Branch)		2/
WE-38 (Westfield River - West Branch)	5,600,000	212,000
WE-39 (Westfield River)	10,746,800	644,800
WE-40 (Bradley Brook)	1,885,300	84,500
WE-41 (Russell Brook)		2/
WE-42 (Little River)	3,816,900	229,000
WE-43 (Munn Brook)	172,500	9,900
WE-44 (Powdermill Brook)		2/
WE-45 (Great Brook)		2/
WE-46 (Paucatuck Brook)	418,600	30,900
-Farmington River Watershed-		
FA-52 (Salmon Brook)		2/
FA-53 (Upper West Branch - Farmington River)		2/
FA-54 (West Branch - Farmington River)		2/

TABLE 5.11 - cont. PRESENT FLOOD DAMAGES[1/]

Subwatershed	100-Year Flood Damage	Average Annual Damage
-Farmington River Watershed- cont.		
FA-55 (Clam River)	390,000	23,400
FA-56 (West Branch - Farmington River)		2/
FA-57 (Sandy Brook)		2/
FA-58 (Upper East Branch - Farmington River)		2/
-Connecticut River Valley Watershed-		
CV-17 (Russelville Brook)		2/
CV-18 (Sawmill River)		2/
CV-19 (Mill River)	124,000	6,500
CV-20 (Mill River)		2/
CV-21 (Fort River)		2/
CV-22 (Mill River)	622,600	48,100
CV-23 (Broad Brook)	1,244,200	149,300
CV-24 (Manhan River)	79,000	17,600
CV-25 (Bachelor Brook)		2/
CV-26 (Stony Brook)		2/
-Chicopee River Watershed-		
CP-27 (Quabbin Reservoir)		2/
CP-28 (Swift River)	200,000	12,000
CP-29 (Ware River)		2/
CP-30 (Danforth Brook)	277,000	16,600
CP-31 (Ware River)		2/
CP-32 (Upper Quaboag River)	710,000	111,900
CP-33 (Lower Quaboag River)	157,600	9,500
CP-34 (Twelve Mile Brook)		2/
CP-35 (Chicopee River)	172,500	10,400
-Southern Connecticut River Valley Watershed-		
SC-47 (Mill River)		2/
SC-48 (Longmeadow Brook)		2/
SC-49 (Freshwater Brook)		2/
SC-50 (Stony River)		2/
SC-51 (Scantic River)		2/

1/ Price Base 1976. Main Stem Connecticut River damages are excluded.

2/ Average annual damages are less than $5,000.

SCS PHOTO

Flooding of agricultural and residential land on the flood plain in the Manhan Meadows section of Northampton in 1969.

SCS PHOTO SCS PHOTO

The same gully in tilled cropland on the banks of the Connecticut River. Photos are only a few years apart.

5.4 EROSION AND SEDIMENT

Soil erosion results from the action of moving water, wind, gravity, frost, or a combination of these forces on the land. In the region, the main concerns are water-activated erosion and its by-product--sedimentation. In addition, natural or geologic erosion should be differentiated from accelerated erosion.

> "Natural or geologic erosion is a continuing process and will go on into the future regardless of anything man can do. Quickening of the pace of erosion, owing to changes wrought by man, has produced definitely abnormal conditions. Accelerated erosion, an abnormal and undesirable process, was started by man's activities and is subject to his control."[10/]

Sheet, rill, gully, stream and roadbank erosion occur in the region; but, in general, the erosion rate is low in comparison to the southern or western portions of the country.

Once erosion has taken place, the eroded material will usually create a second problem when deposited downstream in ditches, stream channels, reservoirs, lakes, wetlands and rivers. Along with the individual soil particles which constitute sediment, any fertilizer, pesticides, animal waste, or other organic matter attached to or adjacent to the soil particles, is also carried off. Some of this also reaches streams and results in a lowering of water quality.

Erosion and sediment problems have historically been corrected with land treatment measures which are the application of a combination of practices that will meet specific objectives. These objectives include controlling soil erosion, decreasing runoff of rainfall, improving soil and plant productivity, improving wildlife habitat, and improving environmental quality. The practices are classified as management, vegetative and cultural, or mechanical.

Mechanical practices include diversions, terraces, waterways, outlets, and small grade stabilization structures. These practices are designed to reduce erosion by reducing the length of slope and by providing proper courses for transporting the water at nonerosive velocities. When used with vegetative practices, mechanical practices can be extremely effective in reducing erosion.

Examples of vegetative and cultural practices are: conservation cropping systems, minimum tillage, cover cropping, contour strip cropping, and planting of grasses, legumes, proper grazing use, shrubs and trees on critical areas. These practices protect the soil from the impact of raindrops, reduce runoff, and reduce the contact between soil particles and flowing water.

Timber stand improvement, timely field operations, recreation and wildlife area management, and maintenance operations are all examples of management practices. These practices minimize the overuse of the land while, at the same time, improve the condition of the cover.

As mentioned, land treatment is planned for other objectives besides erosion control, but adequate protection of the soil is of primary importance. Land treatment has been found to be as effective in urban applications as it is in the rural sector.

In addition to land treatment measures, land use planning and structural measures are also applied to minimize erosion. Land use planning can be developed to guide the use, growth and development of land in the cities and towns. Land subject to excessive erosion can be converted to other land uses which have a lower erosion rate. Areas, such as flood plains and steep slopes, can be managed to reduce erosion and sediment damage.

Structural measures can be designed and used to protect the land from erosion and sediment. Some of the appropriate measures are debris basins, riprapping, channel modifications, and grade stabilization structures. Erosion and sedimentation can be reduced by decreasing high stream flows with flood control measures. Impoundments and natural storage basins will also collect the sediment in the stream and reduce sediment deposits downstream. The water quality in the stream would also be improved by reducing sediment loads.

Erosion--To assess the extent of the erosion and sediment problems in the region, the land was divided into three types based on its general susceptibility to erosion. These "Erosion Land Types" were: (1) upland, (2) terrace, and (3) flood plain. Location and extent of the types are shown on Figure 5.10.

Potential erosion problem areas were listed to insure that all categories of erosion were considered. Based on the judgement of Soil Conservation Service field technicians, the following types of areas were thought to represent the major erosion potential: farmland in cultivation, forest land being harvested, roadbanks, unpaved roads, gravel pits, construction areas, streambanks, and utility rights-of-way.

These potential erosion problems were studied, using a sampling basis to determine the extent of the erosion. Samples were made in each of the three "Erosion Land Type" areas. Soil Conservation Service technicians visited known problem areas to quantify the erosion. Gravel pits and construction areas were also selected based on known problems or areas which appeared to have potential problems. Forest land erosion rates were estimated by Forest Service personnel. Erosion from roadbanks, unpaved roads, streambanks, and utility rights-of-way was estimated by inventorying the problems noted along a specified length of sample reach.

These erosion samples and case studies formed the basis for calculating erosion rates for the various problem types of each "Erosion Land Type." The MacConnell's Massachusetts Map Down series was used to determine the number of acres in various land uses in each "Erosion Land Type." In addition, the 1974 Census of Agriculture land use data was used to refine and adjust the agricultural land use figures used here. Total erosion estimates for the Connecticut River Region are presented in Table 5.12.

Gravel pits and roadbanks, two of the area's erosion problems, were found upon field examination to be rather minor.

Gravel pits and other earth removal operations with their disruption of vegetation and steep slopes were thought to be potential erosion and sediment problems. Examination showed that although erosion of side slopes was indeed a severe problem in terms of the volume of soil being moved, in most instances little or no material left the actual gravel pit, thus, eliminating the offsite sediment problem. It seems that what appeared to be a major source of sediment was rarely a problem beyond the limits of the removal operation. This is probably due to the fact that 70 percent of the communities have bylaws which effectively regulate gravel and earth removal activities. These communities are shown on Figure 5.11.

Erosion along roadways was found to be a minor problem in the region. Isolated severe cases of roadbank erosion exist, but they represent only a small percentage of the total roadbank mileage.

Total gross erosion from developed urban areas is relatively low (57,000 tons per year). In urban areas, almost all of the land surface is covered with roofs, paved with asphalt or other material or is in permanent vegetation. The annual erosion rate of urban land is estimated to be 0.4 ton per acre.

The most significant erosion problems of the region are erosion from tilled cropland, construction sites, and streambanks.

The highest erosion was in sites under construction with an estimated average erosion rate of 72 tons per acre. This figure varies widely, depending on site topography, site geology, construction practices, and time of year. Construction areas have the highest rates of erosion since they usually involve the removal of protective vegetation, exposing bare soil to the eroding effects of water and wind.

Implementing appropriate erosion control practices during construction can do much to reduce the rate and extent of erosion. The Soil Conservation Service's publication, "Guidelines for Soil and Water Conservation in Urbanizing Areas of Massachusetts" details some erosion control practices that can be utilized on construction sites. Erosion

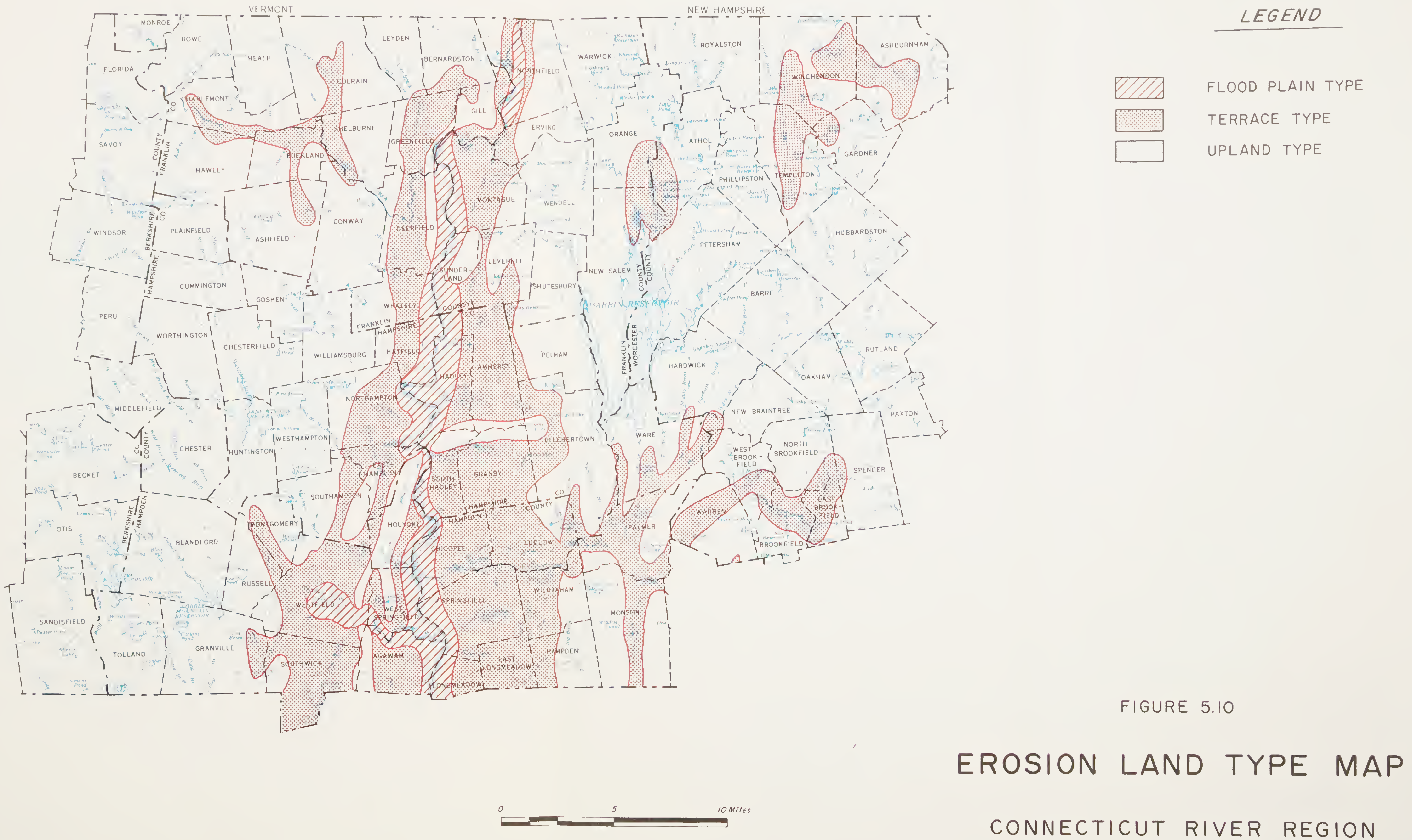
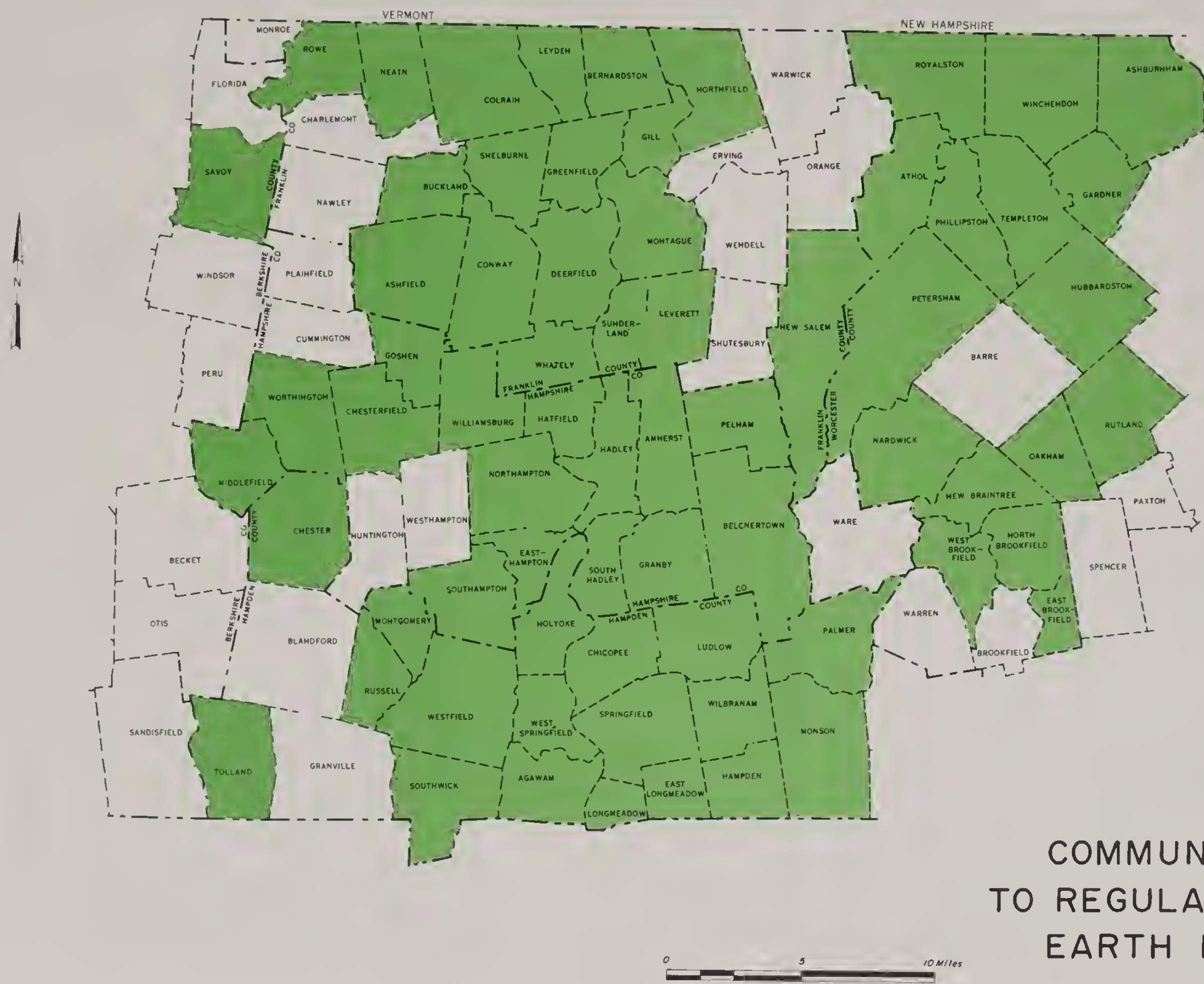


FIGURE 5.10

EROSION LAND TYPE MAP

CONNECTICUT RIVER REGION
MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



LEGEND

COMMUNITIES WITH REGULATIONS

FIGURE 5.11

COMMUNITIES WITH BY-LAWS TO REGULATE GRAVEL PITS AND EARTH REMOVAL ACTIVITIES

CONNECTICUT RIVER REGION

MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TABLE 5.12 EROSION DATA

Land Use	Area (acres)	Annual Erosion Rate (tons/acres)	Annual Erosion (tons)
Connecticut River Region			
1. Tilled Cropland	30,158	(7.1)	214,760
2. Other Agricultural Land	(147,588)	(0.4)	(56,791)
2.1 Orchards, bushfruit and nurseries	4,639	0.4	1,633
2.2 Pasture, hayland and unused tilled cropland	142,949	(0.4)	55,158
3. Other lands (abandoned fields and orchards, etc.)	65,557	0.4	24,205
4. Forest (does not include wooded swamps)	1,247,640	0.2	298,860
5. Wetlands, wooded swamps (non-sediment producing)	69,875	0	0
6. Urban	142,636	0.4	57,364
7. Construction Sites (annual)	4,411	72.	317,592
LAND EROSION TOTAL	1,707,865	(0.6)	969,572
8. Streambanks susceptable to erosion	(miles)	(tons/mile)	
Major Streams	248	376	93,142
Tributaries	303	827	250,716
TOTAL EROSION			1,313,430
Berkshire County (part)			
1. Tilled Cropland	400	10.4	4,160
2. Other Agricultural Land	(4,750)	(0.6)	(2,834)
2.1 Orchards, bushfruit and nurseries	7	0.6	4
2.2 Pasture, hayland and unused tilled cropland	4,743	0.6	2,830
3. Other lands (abandoned fields and orchards, etc.)	4,883	0.6	2,930
4. Forest (does not include wooded swamps)	139,615	0.3	41,885
5. Wetlands, wooded swamps (non-sediment producing)	6,987	0	0
6. Urban	4,868	0.5	2,434
7. Construction Sites (annual)	235	72.	16,920
LAND EROSION TOTAL	161,738	(0.4)	71,163

TABLE 5.12 - cont. EROSION DATA

Land Use	Area (acres)	Annual Erosion Rate (tons/acres)	Annual Erosion (tons)
Franklin County			
1. Tilled Cropland	8,070	(7.3)	59,336
2. Other Agricultural Land	(44,826)	(0.6)	(26,851)
2.1 Orchards, bushfruit and nurseries	1,246	0.6	748
2.2 Pasture, hayland and unused tilled cropland	43,580	0.6	26,103
3. Other lands (abandoned fields and orchards, etc.)	15,702	0.6	9,421
4. Forest (does not include wooded swamps)	353,696	0.3	106,109
5. Wetlands, wooded swamps (non-sediment producing)	8,635	0	0
6. Urban	18,947	0.5	9,474
7. Construction Sites (annual)	656	72.	47,232
LAND EROSION TOTAL	450,532	(0.6)	258,423

Land Use	Area (acres)	Annual Erosion Rate (tons/acres)	Annual Erosion (tons)
Hampden County (part)			
1. Tilled Cropland	5,441	(6.2)	33,625
2. Other Agricultural Land	(24,914)	(0.2)	(5,099)
2.1 Orchards, bushfruit and nurseries	1,342	0.2	268
2.2 Pasture, hayland and unused tilled cropland	23,572	0.2	4,831
3. Other lands (abandoned fields and orchards, etc.)	16,293	0.2	3,259
4. Forest (does not include wooded swamps)	223,894	0.2	44,779
5. Wetlands, wooded swamps (non-sediment producing)	10,061	0	0
6. Urban	70,446	0.4	28,178
7. Construction Sites (annual)	1,910	72.	137,520
LAND EROSION TOTAL	352,959	(0.7)	252,460

TABLE 5.12 - cont. EROSION DATA

Land Use	Area (acres)	Annual Erosion Rate (tons/acres)	Annual Erosion (tons)
Hampshire County			
1. Tilled Cropland	12,222	(6.4)	78,614
2. Other Agricultural Land	(37,422)	(0.3)	(11,258)
2.1 Orchards, bushfruit and nurseries	1,498	0.3	449
2.2 Pasture, hayland and unused tilled cropland	35,924	0.3	10,809
3. Other lands (abandoned fields and orchards, etc.)	12,235	0.3	3,671
4. Forest (does not include wooded swamps)	237,420	0.2	47,484
5. Wetlands, wooded swamps (non-sediment producing)	10,061	0	0
6. Urban	27,657	0.4	11,063
7. Construction Sites (annual)	970	72.	69,840
LAND EROSION TOTAL	337,987	(0.7)	221,930

Land Use	Area (acres)	Annual Erosion Rate (tons/acres)	Annual Erosion (tons)
Worcester County (part)			
1. Tilled Cropland	4,025	(9.7)	39,025
2. Other Agricultural Land	(35,676)	(0.3)	(10,749)
2.1 Orchards, bushfruit and nurseries	546	0.3	164
2.2 Pasture, hayland and unused tilled cropland	35,130	0.3	10,585
3. Other lands (abandoned fields and orchards, etc.)	16,444	0.3	4,933
4. Forest (does not include wooded swamps)	293,015	0.2	58,603
5. Wetlands, wooded swamps (non-sediment producing)	34,131	0	0
6. Urban	20,718	0.3	6,215
7. Construction Sites (annual)	640	72.	46,080
LAND EROSION TOTAL	404,649	(0.4)	165,605

control measures during construction add minimally to the total construction cost, but many contractors and owners are reluctant to spend money for "nonconstruction" type measures. Many communities have some minor control of erosion during construction through zoning, building, or other bylaws. This method is not very effective and fails to cover many aspects of the problem.

Soil scientists estimate that to maintain productivity over time, annual soil losses on most Massachusetts' agricultural soils must be limited to no more than 3 tons per acre. The regional average erosion rate of tilled cropland of 7.1 tons per acre per year is slightly more than double this maximum tolerable annual soil loss. Erosion on about 80 percent of this tilled land, however, is less than the tolerable annual soil loss. The high average is from excessive losses on less than 20 percent of the tilled land and generally results from poor management. On certain individual farms sampled, annual erosion rates of over 30 tons per acre were computed for areas in field corn.

Establishment and maintenance of good conservation practices by the majority of the region's farm operators has done much to reduce total erosion from farmland. However, more needs to be done by those remaining who have erosion problems on their land.

Streambank erosion accounts for approximately 25 percent of the total erosion and is, therefore, a much more serious erosion problem in this region than in the Central and Coastal Regions to the east. Over 50 percent of the sediment delivered to streams and rivers originates from streambank erosion.

The U.S. Army Corps of Engineers is now conducting the Connecticut River Streambank Erosion Study. This is a study of erosion problems on the riverbanks in the flood pools of the Turners Falls Dam in Massachusetts and other electrical power dams on the Connecticut River in New Hampshire and Vermont. Erosion of these riverbanks are aggravated by a rapid drawdown of the storage pools. Although the final results of the Corps' study are not yet available, the power company has recently spent considerable effort clearing and stabilizing these riverbanks in the towns of Gill and Northfield above the Turners Falls Dam.

Sampling and other surveys have shown there are few erosion problems in wetlands, pasture, forest, orchards, abandoned fields, and established urban areas.

Sediment--If the entire volume of erosion in the region were to result in sediment delivered to streams and rivers, the results would be catastrophic. However, a large percentage of the sediments are deposited on stone walls, fence rows and other strips of vegetation, forest land,

and even flat slopes before reaching a watercourse. Delivery rates of sediment to streams are estimated to be 12 percent or less of the original eroded volume.

On the other hand, erosion from streambanks results in a very high percentage of eroded material becoming sediment. Cobbles and boulders usually remain fairly close to their original location, sand may settle out in the flat stretches of streams and in pools, but the fine sand and silt fraction remains as suspended sediment to dirty the water and reduce its value as fish habitat and as habitat for insects in the fish food-chain.

Suspended sediment measurement stations have been established throughout Massachusetts by the U.S. Geological Survey. These stations are located on major streams and monitor suspended sediment at the USGS stream gage locations. Station locations and pertinent data are shown on Figure 5.12 and Table 5.13.

Flow-duration data combined with suspended sediment readings were used to prepare average annual sediment data for each station. Although the data have significant scatter when plotted, they present an estimate of values to be expected for the suspended sediment. The range of values is between 0.015 ton/acre and 0.16 ton/acre. There appears to be little correlation between the size of drainage area and the amount of suspended sediment per unit area. Factors such as upstream wetlands and dams which act as sediment traps, and effluents from sewage treatment plants are responsible for much of the variation.

Based on the analysis of suspended sediment data and estimates of quantities of the larger sized "bedload" sediment, it is estimated that the total average annual sediment in the rivers and streams of the region is approximately 158,000 tons or about 12 percent of the total erosion in the region.

TABLE 5.13 SEDIMENT ESTIMATES AT SELECTED STREAM GAGES

Stream Gage	Drainage Area Sq. Miles	Suspended Sediment Tons/Sq. Mile	Total Sediment Tons/Sq. Mile
Connecticut River at Thompsonville, Ct.	9,661	59.0	61.7
Westfield River near Westfield, Mass.	497	81.9	84.6
West Branch of the Westfield River at Huntington, Mass.	93.7	11.6	13.5
Quaboag River at West Brimfield, Mass.	151	12.9	15.6
Deerfield River near West Deerfield, Mass.	558	49.2	51.9
Deerfield River at Charlemont, Mass.	362	28.0	30.7
North River at Shattuckville, Mass.	88.4	63.3	65.2
South River near Conway, Mass.	24	99.8	101.7

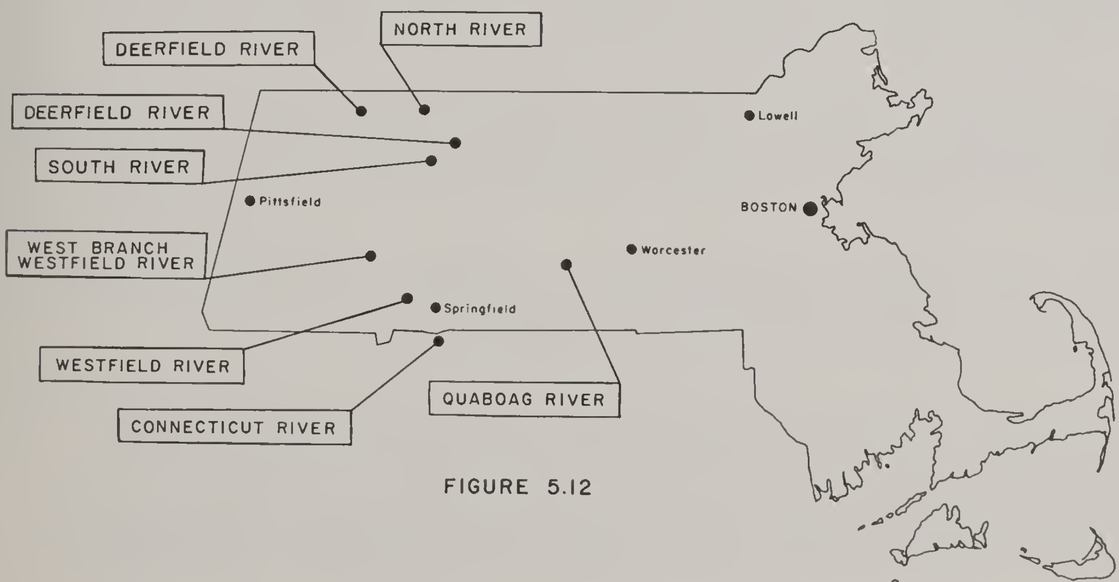


FIGURE 5.12

5.5 WETLANDS

Wetlands are defined as those areas where the water table is at or near the ground surface for much of the year and are subject to occasional flooding. In the region, wetlands include swamps, marshes, bogs, beaver ponds, seasonally flooded flats, and wet meadows. The soils of the wetlands are usually poorly or very poorly drained, except for beaver ponds and seasonally flooded flats. The latter are usually alluvial or flood plain soils which may have better drainage.

Table 5.14, Wetland Regional Summary, and Table 5.15, Wetland Areas, list wetland acreages of the region's study areas and municipalities. The smallest wetlands inventoried are approximately three acres in size.

The wetland figures do not include flood plain lands that are dry most of the year, although these usually dry portions of flood plains are in the same jurisdictional category as wetlands in Massachusetts wetland legislation. The approximate 69,600 acres of inland wetlands in the region represent 4 percent of the total area. The range is from 0.2 percent in Buckland and Charlemont to 13.8 percent in Hubbardston.

Wetlands are important for flood control, wildlife habitats, and to a lesser degree, for water quality, and ground water aquifer protection. In addition, wetlands are extremely poor sites for industrial, commercial, and residential development because of high water tables, the flooding hazard, and the possibility of organic materials in the soils underlying the foundation. High water tables eliminate the use of septic tank and leach field systems for onsite sewage disposal, create serious site drainage problems, and make the use of building basements impractical and often impossible. The presence of organic material--muck or peat--in a foundation often results in differential settlement and cracking of the structure or fill. Removal of mucks and peats, particularly deep deposits, is usually a necessity for all but the lightest of fills or structures.

Wetlands act as natural floodwater retarding basins which lower downstream peak flood flows. Loss of these storage areas can result in significantly higher flood peaks and more extensive flooding downstream.

Many wildlife species depend directly on wetlands for food and habitat. As a result, wetlands provide many opportunities for recreational activities such as hunting and wildlife observation.

Stream water quality can be either adversely or advantageously modified by wetlands. Adverse modification can occur when wetland aquatic plants, including algae, die and decay. During this decomposition, dissolved oxygen can be lowered to inadequate levels to sustain fish and other aquatic animal life. Often, this situation is triggered by nutrient loadings from upstream domestic or industrial waste water

TABLE 5.14 WETLAND REGIONAL SUMMARY

Study Area	Inland Wetlands: Open Type 1/ 2/	Inland Wetlands: Wooded Swamps 3/	Inland Wetlands: Total	Fresh Open Water 4/	Grand Total
	Acres				
Chicopee	8,901	18,302	27,203	29,978	57,181
Deerfield	1,712	1,460	3,172	533	3,705
Central Connecticut Valley	3,298	4,254	7,552	3,356	10,908
Westfield	3,592	4,189	7,781	4,086	11,867
Millers	5,389	9,409	14,798	4,066	18,864
Southern Connecticut Valley	425	2,399	2,824	521	3,345
Farmington	2,918	2,584	5,502	3,864	9,366
Northern Connecticut Valley	359	412	771	45	816
Totals	26,594	43,009	69,603	46,449	116,052

1/ Massachusetts Map Down Project, University of Massachusetts, 1971.

2/ These open type wetlands, as mapped by MacConnell et al., are based on the wetlands classification presented in Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service. The Massachusetts Map Down wetland types included in the open type wetlands column above and the equivalent wetland type of the U.S. Fish and Wildlife Service, Circular 39, are as follows: Seasonally flooded basins or flats--Type 1; Bog--Type 8; Shrub Swamp--Type 6; Meadow--Type 2; Shallow Marsh--Type 3; Deep Marsh--Type 4; Beaver Pond--Type 3 or 4.

3/ Measured by the Soil Conservation Service. This is equivalent of Type 7, Circular 39.

4/ This is equivalent of Type 5, Circular 39.

TABLE 5.15 WETLAND AREAS

Municipality	Open 1/2/ Wetlands (acres)	Wooded 3/ Swamps (acres)	Total Inland Wetlands (acres)	Total % of Municipal Area	Fresh 4/ Open Water (acres)	Total Wetland & Open water (acres)	Total % of Municipality Area
			Central Connecticut Valley Study Area				
Amherst	1,015	747	1,762	10.0	10	1,772	10.0
Chicopee	25	184	209	1.4	68	277	1.9
Deerfield	135	131	266	1.3	0	266	1.3
Easthampton	33	4	37	0.4	54	91	1.0
Granby	362	687	1,049	5.9	124	1,173	6.5
Hadley	415	95	510	3.1	72	582	3.5
Hatfield	156	186	342	3.2	70	412	3.9
Holyoke	62	242	304	2.1	505	809	5.5
Leverett	131	191	322	2.2	43	365	2.5
Montague	119	99	218	1.1	62	280	1.4
Northampton	164	343	507	2.2	320	827	3.7
Pelham	126	209	335	2.1	915	1,250	7.8
Shutesbury	125	355	480	2.8	355	835	4.9
South Hadley	102	73	175	1.5	54	229	1.9
Southampton	111	163	274	1.4	430	704	3.7
Sunderland	11	48	59	0.6	31	90	1.0
Westhampton	82	70	152	0.9	118	270	1.6
Whately	15	80	95	0.7	71	166	1.3
Williamsburg	109	347	456	2.8	54	510	3.1
Subtotals	3,298	4,254	7,552	2.5	3,356	10,908	3.7
			Westfield Study Area				
Becket	807	722	1,529	5.0	829	2,358	7.8
Blandford	755	440	1,195	3.5	1,235	2,430	7.2
Chester	113	208	321	1.4	277	598	2.5
Chesterfield	375	211	586	2.9	131	717	3.5
Cummington	59	88	147	1.0	0	147	1.0
Goshen	255	214	469	4.1	165	634	5.5
Huntington	84	27	111	0.7	122	233	1.4
Middlefield	114	154	268	1.7	14	282	1.8
Montgomery	27	185	212	2.1	47	259	2.6
Peru	165	251	416	2.5	70	486	2.9
Plainfield	22	157	189	1.4	121	310	2.3
Russell	18	77	95	0.9	87	182	1.6
Southwick	152	471	623	3.1	519	1,142	5.7
Westfield	164	339	503	1.7	315	818	2.7
W. Springfield	30	166	196	1.7	37	233	2.1
Windsor	259	248	507	2.3	84	591	2.7
Worthington	193	221	414	2.1	33	447	2.2
Subtotals	3,592	4,189	7,781	2.4	4,086	11,867	3.7
			Millers Study Area				
Ashburnham	699	1,940	2,639	10.0	1,582	4,221	16.0
Athol	616	195	811	3.8	520	1,331	6.2
Erving	26	26	52	0.6	51	103	1.1
Gardner	399	1,155	1,554	10.5	460	2,014	13.6
Orange	435	628	1,063	4.7	220	1,283	5.7
Royalston	927	1,150	2,077	7.7	350	2,427	8.9
Templeton	800	1,504	2,304	11.4	136	2,440	12.1
Warwick	487	480	967	3.7	151	1,118	4.3
Wendell	245	361	606	2.8	132	738	3.4
Winchendon	755	1,970	2,725	9.7	464	3,189	11.3
Subtotals	5,389	9,409	14,798	6.8	4,066	18,864	8.7

TABLE 5.15 - cont. WETLAND AREAS

Municipality	Open 1/2/ Wetlands (acres)	Wooded 3/ Swamps (acres)	Total Inland Wetlands (acres)	Total % of Municipal Area	Fresh 4/ Open Water (acres)	Total Wetland & Open water (acres)	Total % of Municipality Area
			Chicopee Study Area				
Barre	701	1,075	1,776	6.1	127	1,903	6.6
Belchertown	452	1,191	1,643	4.6	1,768	3,411	9.6
Brookfield	671	590	1,261	11.9	676	1,937	18.3
E. Brookfield	285	460	745	11.2	333	1,078	16.2
Hardwick	465	565	1,030	3.9	1,419	2,449	9.4
Hubbardston	664	3,049	3,713	13.8	609	4,322	16.1
Ludlow	366	483	849	4.7	570	1,419	7.9
Monson	70	512	582	2.0	115	697	2.4
New Braintree	334	545	879	6.5	78	957	7.1
New Salem	610	496	1,106	2.9	8,975	10,081	26.5
N. Brookfield	183	647	830	5.9	408	1,238	8.8
Oakham	145	735	880	6.5	185	1,065	7.8
Palmer	75	274	349	1.8	163	512	2.6
Paxton	225	937	1,162	11.7	442	1,604	16.2
Petersham	1,147	986	2,133	4.9	8,616	10,749	24.7
Phillipston	672	1,427	2,099	13.1	230	2,329	14.6
Rutland	757	2,243	3,000	13.2	582	3,582	15.7
Spencer	252	1,108	1,360	6.2	753	2,113	9.7
Ware	265	370	635	2.5	3,540	4,175	16.3
Warren	189	279	468	2.7	44	512	2.9
W. Brookfield	373	330	703	5.1	345	1,048	7.5
Subtotals	8,901	18,302	27,203	6.3	29,978	57,181	13.3
			Deerfield Study Area				
Ashfield	452	344	796	3.1	73	869	3.4
Buckland	19	10	29	0.2	11	40	0.3
Charlemont	15	21	36	0.2	0	36	0.2
Colrain	30	96	126	0.5	44	170	0.6
Conway	259	168	427	1.8	0	427	1.8
Florida	59	28	87	0.6	18	105	0.7
Greenfield	172	81	273	1.8	6	279	1.9
Hawley	47	246	293	1.5	15	308	1.6
Heath	70	132	202	1.3	22	224	1.4
Leyden	49	28	77	0.7	11	88	0.8
Monroe	19	8	27	0.4	2	29	0.4
Rowe	91	39	130	0.8	233	363	2.3
Savoy	234	194	428	1.9	98	526	2.3
Shelburne	176	65	241	1.6	0	241	1.6
Subtotals	1,712	1,460	3,172	1.3	533	3,705	1.5
			Southern Connecticut Valley Study Area				
Agawam	16	137	153	1.0	29	182	1.2
East Longmeadow	11	523	534	6.5	7	541	6.6
Hampden	99	553	652	5.2	18	670	5.4
Longmeadow	69	116	185	3.0	5	190	3.1
Springfield	116	356	472	2.2	409	881	4.1
Wilbraham	114	714	828	5.8	53	881	6.2
Subtotals	425	2,399	2,824	3.6	521	3,345	4.3

TABLE 5.15 - cont. WETLAND AREAS

Municipality	Open 1/2/ Wetlands (acres)	Wooded 3/ Swamps (acres)	Total Inland Wetlands (acres)	Total % of Municipal Area	Fresh 4/ Open Water (acres)	Total Wetland & Open water (acres)	Total % of Municipality Area
			Farmington Study Area				
Granville	199	218	417	1.5	525	942	1.9
Otis	1,199	1,186	2,385	9.8	1,670	4,055	16.6
Sandisfield	1,036	599	1,635	4.9	770	2,405	7.2
Tolland	484	581	1,065	5.1	899	1,964	9.4
Subtotal	2,918	2,584	5,502	5.2	3,864	9,366	8.8
			Northern Connecticut Valley Study Area				
Bernardston	40	157	197	1.3	0	197	1.3
Gill	86	51	137	1.4	11	148	1.6
Northfield	233	204	437	2.0	34	471	2.1
Subtotal	359	412	771	1.6	45	816	1.7
Region Total	26,594	43,009	69,603	4.0	46,449	116,052	6.7

1/ Massachusetts Map Down Project, University of Massachusetts, 1971.

2/ These open type wetlands, as mapped by MacConnell et al., are based on the wetlands classification presented in Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service. The Massachusetts Map Down wetland types included in the open type wetlands column above and the equivalent wetland type of the U.S. Fish and Wildlife Service, Circular 39, are as follows: Seasonally flooded basins or flats--Type 1; Bog--Type 8; Shrub Swamp--Type 6; Meadow--Type 2; Shallow Marsh--Type 3; Deep Marsh--Type 4; Beaver Pond--Type 3 or 4.

3/ Measured by the Soil Conservation Service. This is equivalent of Type 7, Circular 39.

4/ This is equivalent of Type 5, Circular 39.

effluents. Wetlands can also enhance water quality by acting as sediment traps and nutrient filters. The quality of the incoming water and the condition of the wetland must be known to determine how a particular wetland will affect water quality.

In the region, the major ground water aquifers are usually in the bottom lands or flood plains along or near the major streams. These aquifers are often overlain by wetlands. Some protection to underlying aquifers can be provided by maintaining these wetlands.

Most inland wetlands, during normal or dry periods, act as areas of ground water discharge. During times of flood, however, there is the possibility of recharge into ground water storage areas through their wetlands cover. Also, the storing of flood water in upland wetlands and the releasing of lower flows for a longer period of time may allow advantageous recharge conditions to develop downstream.

The Massachusetts Water Resources Study has evaluated 79 of the largest inland wetlands in the Connecticut River Region. The wetlands were studied for their value for forest management, flood control, fish habitat, wetland wildlife habitat, recreation, uniqueness, and visual quality. The methodology and criteria employed in the evaluation is discussed in Appendix B. Results of the evaluations are presented in Table 5.16. Figure 5.13 indicates the location of the wetlands that were evaluated.

The wetland evaluations are not intended to be used as the sole tool to rank wetlands within the region, nor should a "Low" rated wetland be considered a prime candidate for filling and development. Rather, the ratings can be used to indicate those wetlands which are obviously important to the water resources of the region. Wetlands which are rated "High" for a number of categories should also have high priority for acquisition by government, or protection by restrictions through conservation easements. Wetlands which are rated "Low" in most categories may not be too important from a water resources standpoint. This wetland evaluation is one aid to establishing priorities in wetlands protection. A caution needs to be reemphasized at this point. However, even a wetland which rates "Low" for all evaluated purposes should not be considered suitable for development. Because of the severe limitations imposed by wet conditions, all wetlands can also be rated "Low" in suitability for development. Flood hazards, year-round problems with standing water, foundation problems, and septic system failures are some of the problems that may be encountered by those owning developed property on former wetlands.

Public and quasi-public ownership and the zoning of privately owned wetlands are important facets of the wetlands picture in the region. Publicly and quasi-publicly owned wetlands are usually more secure from encroachment and development than privately owned areas. Many

TABLE 5.16

SUMMARY OF WETLAND EVALUATION RESULTS

Wetland Number	Location Description	Wetland Size (acres)	Wetland Types[1/] (acres) 1	2	3	4	5	6	7	8	Evaluation Rating for: Forest Manage-ment	Flood Control	Fish Habitat	Wetland Wildlife Habitat	Recre-ation	Unique-ness	Visual Quality
MI-1	North Fitzwilliam Rd., Swamp, Royalston	237			70			12	155		High	Low	N.R.	High	Low	High	Mod.
MI-2	Beaver Brook Swamp, Royalston	218	20		165			13	20		Low	Low	N.R.	High	Low	Low	Mod.
MI-3	Tully River Swamp, Royalston	173	65		15			55	38		High	N.R.	N.R.	Mod.	Low	High	High
MI-4	Lawrence Brook Swamp, Royalston	175	90					50	35		Mod.	Low	N.R.	Mod.	Low	High	Low
MI-5	Nineteenth Hill Swamp, Winchendon	190							190		Mod.	Mod.	N.R.	Low	Low	Low	Mod.
MI-6	Priest Brook Swamp, Royalston, Winchendon	168	78		56			16	18		High	Low	N.R.	Mod.	Low	High	Mod.
MI-7	Cheshire Pond Swamp, Ashburnham	399			22	17		77	283		High	Mod.	N.R.	Mod.	Low	High	High
MI-8	Thousand Acre Swamp, Phillipston, Athol	188	95		25			23	45		Mod.	Mod.	N.R.	Mod.	Low	High	Low
MI-9	Doe Valley Swamp, Athol	281			40	48	55	20	118		Mod.	High	High	High	Mod.	High	High
MI-10	Otter River Wetland, Gardner, Hubbardston, Templeton	370	20		60	20		90	180		High	High	N.R.	Mod.	Mod.	High	High
MI-11	So. Gardner - Rte. 2A Wetland, Gardner, Westminster	120			20			20	80		Low	Mod.	N.R.	Mod.	Low	High	Mod.
MI-12	Union Street Wetland, Gardner, Hubbardston	170						15	155		High	Mod.	N.R.	Mod.	Low	High	Low
MI-13	Darling Brook Swamp, Warwick	150	28					24	98		Mod.	Low	N.R.	Mod.	Low	Low	Mod.
MI-14	Cheney Brook Swamp, Orange	95			63	32					N.R.	Low	N.R.	Mod.	Low	Low	Mod.
MI-15	Plains Road Swamp, Wendell	138			6	60		20	52		Low	Mod.	N.R.	Mod.	Mod.	Low	Mod.
MI-16	Harris Swamp, Warwick	78						38	40		Mod.	Mod.	N.R.	Mod.	Low	Low	Mod.
MI-17	Coolidge Swamp, Orange	74							74		High	Low	N.R.	Low	Low	Low	Mod.
MI-18	Lake Rohunta Wetland, New Salem, Athol	730			17	268	173	81	191		High	Mod.	High	High	High	High	High
NC-1	Bass Swamp, Warwick	76	34		8	22			12		Mod.	Mod.	N.R.	Mod.	Mod.	Low	Mod.
NC-2	Stevens Swamp, Warwick, Northfield	80					19	55	6		Low	Mod.	Low	Mod.	Mod.	High	Mod.
DE-1	Cranberry Swamp, Hawley	66				6			55	5	Mod.	Mod.	N.R.	Mod.	Low	High	Mod.
DE-2	Basin Brook Swamp, (Hells Kitchen), Hawley	59			4	18			37		Mod.	Mod.	N.R.	Mod.	Low	High	Mod.
DE-3	Fuller Swamp, Deerfield	92		20	10	10			52		High	Low	N.R.	Mod.	Low	Low	Mod.
CP-1	Popple Camp Wetland, Philliston, Petersham	150			10			95	45		Mod.	Low	N.R.	Mod.	Low	High	Mod.
CP-2	Burnshirt Swamp, Templeton, Phillipston	220			40	30		80	70		Mod.	Mod.	N.R.	High	Mod.	High	Mod.
CP-3	Loring Swamp, Hardwick	274			17				257		High	Mod.	N.R.	Mod.	Low	High	Mod.
CP-4	Higgins Swamp, Barre	175						75	100		Mod.	Low	N.R.	Mod.	Low	High	Mod.
CP-5	Loring Hill Swamp, Barre	129			40	13		45	31		Mod.	Mod.	N.R.	Mod.	Low	High	Mod.
CP-6	River Road Wetland, Rutland	160		30	50			55	25		High	Low	N.R.	Mod.	Low	High	Mod.
CP-7	Moosehorn Pond Wetland, Hubbardston	62			25	15		12	10		Low	Mod.	N.R.	Mod.	Mod.	High	Mod.
CP-8	Eames Pond Wetland, Paxton	250			65	15		85	85		Mod.	Mod.	N.R.	High	Mod.	High	High
CP-9	Winimusset Meadows, New Braintree	178		42	4			57	75		High	Mod.	N.R.	Mod.	Low	High	Mod.
CP-10	Hardwick Pond Wetland, Hardwick	125			3	15		85	22		Mod.	Mod.	Mod.	Mod.	Mod.	High	Mod.
CP-11	Tufts Brook Wetland, Warren	129			33	12			84		Mod.	Low	N.R.	Mod.	Mod.	High	High
CP-12	Quaboag River Wetland, Brookfield, West Brookfield	1,080			620	10	150	40	260		High	High	High	High	High	High	High
CP-13	Perry Pond Wetland, North Brookfield, East Brookfield	145			15	10	10	25	85		High	Low	Mod.	Mod.	Mod.	High	High
CP-14	Allen Swamp, East Brookfield	230			130	10	10		80		High	Low	Mod.	High	High	High	High
CP-15	Natty Pond Brook Wetland, Hubbardston	275	25					31	219		High	Mod.	N.R.	Mod.	Low	High	Mod.
CP-16	Barre Falls Wetland, Barre, Rutland, Hubbardston	305	100					120	85		Mod.	N.R.	N.R.	Mod.	Mod.	High	Mod.
CP-17	Coldbrook Swamp, Barre	182	40		3			34	105		Mod.	Low	N.R.	Mod.	Mod.	High	Mod.

FIGURE 5.13

LOCATION OF EVALUATED WETLANDS

CONNECTICUT RIVER REGION
MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TABLE 5.16 - cont. SUMMARY OF WETLAND EVALUATION RESULTS

Wetland Number	Location Description	Wetland Size (acres)	Wetland Types[1/] (acres) 1	2	3	4	5	6	7	8	Evaluation Rating for: Forest Manage-ment	Flood Control	Fish Habitat	Wetland Wildlife Habitat	Recre-ation	Unique-ness	Visual Quality
CP-18	Cedar Swamp, Westminster	180			10	10		20	140		Mod.	Mod.	N.R.	Mod.	Mod.	High	Mod.
CP-19	Chicopee Golf Club Swamp, Chicopee	83							83		High	Low	N.R.	Low	Low	Low	Mod.
CP-20	Jabbish Brook Swamp, Belchertown	115			28	28		46	13		High	Low	N.R.	Mod.	Mod.	Low	Mod.
CP-21	Swift River Wetlands, Palmer	70				63	7				N.R.	Low	Mod.	Mod.	High	High	Mod.
CV-1	Keys Swamp, Conway	51			11	27		4	9		Mod.	Mod.	N.R.	High	Mod.	High	High
CV-2	Nungee Swamp, Williamsburg	101		22					79		High	Mod.	N.R.	Mod.	Low	Low	Mod.
CV-3	Great Pond Wetland, Hatfield	213			91	25	20		77		High	Low	Low	High	Mod.	High	High
CV-4	Lake Warner Wetlands, Hadley	84			9	37	38				N.R.	Low	High	High	High	High	Mod.
CV-5	Great Swamp, Amherst, Hadley, Sunderland	131		48					83		High	Low	N.R.	Mod.	Low	High	Mod.
CV-6	Leverett Pond Wetland, Leverett	92		9	8	38	37				N.R.	High	High	Mod.	High	High	Mod.
CV-7	Hurlberts Pond, Northampton	209	20	23	44	18			104		High	Low	N.R.	High	Mod.	High	Mod.
CV-8	Pitchawam Swamp, Granby	106	2	12	4			10	78		High	Low	N.R.	Mod.	Low	Low	High
CV-9	Porter Swamp, Granby	74		3					71		High	Mod.	N.R.	Mod.	Low	Low	Mod.
CV-10	Lawrence Swamp, Amherst, Belchertown	773		50	18	33		113	559		High	Mod.	N.R.	Mod.	Mod.	High	High
CV-11	Fort River Wetlands, Amherst	121	40	40		2		20	19		High	Mod.	N.R.	Mod.	Low	Low	Mod.
CV-12	Forge Pond Swamp, Granby, Belchertown	92		9	27	14	2	9	31		High	Low	N.R.	Mod.	Mod.	High	Mod.
CV-13	Bachelor Brook Swamp, Belchertown	163		5	2			31	125		High	Low	N.R.	Mod.	Low	Low	Mod.
WE-1	Drowned Land Brook Wetland, Savoy	50			6			30	14		Low	Mod.	N.R.	Mod.	Low	Low	Mod.
WE-2	Drowned Land Brook Wetland, Windsor	97	13			7		13	64		High	Mod.	N.R.	Mod.	Low	Low	Mod.
WE-3	Tower Brook Wetland, Worthington, Cummington	110		4	18	18			70		High	Mod.	N.R.	Mod.	Low	Low	Mod.
WE-4	Bassett Meadow, Ashfield	120		42	9			55	14		Mod.	Low	N.R.	Mod.	Low	Low	Mod.
WE-5	Sears Meadow, Goshen	144			61	20		16	47		Mod.	Mod.	N.R.	Mod.	Low	High	Mod.
WE-6	Dead Swamp, Chesterfield	76			9			33	34		High	Low	N.R.	Mod.	Low	Low	Mod.
WE-7	Fiske Meadow, Chesterfield	138			36	28		53	21		High	Mod.	N.R.	Mod.	Low	High	Mod.
WE-8	Miller Swamp, Blandford	106				10			96		High	Low	N.R.	Mod.	Low	Low	Mod.
WE-9	Beaver Pond Wetland, Blandford	83	27		40	11			5		Mod.	Mod.	N.R.	Mod.	Low	Low	Mod.
WE-10	Chapin and Buck Pond Wetland, Westfield	80				9	31	40			N.R.	Mod.	Mod.	High	Mod.	High	Mod.
WE-11	Ripley Brook Swamp, Granville, Tolland	113	13		3	49		9	39		High	Mod.	N.R.	Mod.	Mod.	High	Mod.
WE-12	Great Brook Swamp, Southwick	82				10	8	40	24		Mod.	Low	Mod.	Mod.	Mod.	High	Mod.
WE-13	Goose Pond Swamp, Southwick	258			23	17	9	13	196		High	Mod.	Low	Mod.	Mod.	High	Mod.
SC-1	Cedar Swamp, Wilbraham	239						14	225		High	Mod.	N.R.	Mod.	Low	High	Mod.
SC-2	Harts Pond Swamp, Southwick, Agawam	130	6		11	5	7	2	99		High	Mod.	Mod.	Mod.	Mod.	High	Mod.
SC-3	Upper Watchaug Brook Swamp, E. Longmeadow	175					2		173		High	Mod.	N.R.	Mod.	Low	Low	Mod.
SC-4	Cedar Swamp, Hampden	133							133		High	Mod.	N.R.	Low	Low	Low	Mod.
FA-1	Tyne Swamp, Becket	185	26		24			14	121		High	Low	N.R.	Mod.	Low	Low	Mod.
FA-2	Mud Pond Wetland, Otis	138					21	24	93		High	Mod.	Mod.	Mod.	Mod.	Low	Mod.
FA-3	Lower Spectacle Pond Swamp, Sandisfield	166			16	11		23	116		High	Mod.	N.R.	Mod.	Low	Low	Mod.
FA-4	Big Pond Swamp, Otis	275	36		17			8	214		High	Mod.	N.R.	Mod.	Low	Low	Mod.
FA-5	Cranberry Pond Brook Swamp, Tolland	82		10		7		47	18		High	Low	N.R.	Mod.	Low	Low	Mod.

1/ Wetland types as classified in Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service are as follows: Type 1--Seasonally flooded flats; Type 2--Inland fresh meadows; Type 3--Inland shallow fresh marshes; Type 4--Inland deep fresh marshes; Type 5--Inland open fresh water; Type 6--Shrub swamps; Type 7--Wooded swamps; and Type 8--Bogs.

towns in the region have acquired wetlands as conservation areas. In other instances, state forests, parks, and wildlife areas encompass wetlands. Land use zoning can also be a major determinant of the future of a wetland.

Public and quasi-public ownership information has been obtained for the wetlands of the region. Public and quasi-public ownership and zoning has also been obtained for the 79-wetlands evaluated for various purposes. Wetland ownership and zoning data is presented in Tables 5.17 and 5.18.

SCS PHOTO

A small wetland along Route 2 in East Templeton. Waterfowl and wading birds are often seen here by passing motorists.

TABLE 5.17 OWNERSHIP AND PROTECTIVE ZONING OF INLAND WETLANDS

Study Area	Total Area Inland Wetlands (acres)	Public and Quasi-Public Ownership (acres)	Public and Quasi-Public Ownership (% of Total)3/	Protective1/ Zoning2/ (acres)	Protective1/ Zoning2/ (% of Total)3/	Total Public Ownership and Protective Zoning (acres)	Total Public Ownership and Protective Zoning (% of Total)3/
Millers	14,798	2,916	19.7	2,900	19.6	5,816	39.3
Northern Connecticut Valley	771	148	19.2	60	7.8	208	27.0
Deerfield	3,172	375	11.8	100	3.2	475	15.0
Chicopee	27,203	5,382	19.8	2,570	9.4	7,952	29.2
Central Connecticut Valley	7,552	1,075	14.2	1,740	23.0	2,815	37.3
Westfield	7,781	899	11.6	270	3.5	11,169	15.0
Southern Connecticut Valley	2,824	457	16.2	420	14.9	877	31.1
Farmington	5,502	1,542	28.0	0	0	1,542	28.0
Region Totals	69,603	12,794	18.4	8,060	11.6	20,854	30.0

1/ Municipal flood plain, conservancy, watershed protection or similar zoning which restricts development activity in wetlands.

2/ Public or quasi-publicly owned wetlands have been subtracted from these figures.

3/ Total area of study area inland wetlands.

TABLE 5.18 OWNERSHIP AND PROTECTIVE ZONING OF EVALUATED WETLANDS

Study Area	Evaluated Wetlands Number	Evaluated Wetlands Area (acres)	Percent of Study Area's Wetlands	Amount in Public or Quasi-Public Ownership (acres)	Amount in Public or Quasi-Public Ownership (%)	Amount Protectively Zoned (acres)	Amount Protectively Zoned (%)	Total Publicly Owned or Protectively Zoned (acres)	Total Publicly Owned or Protectively Zoned (%)
Millers	18	3,954	26.7	377	9.5	221	5.6	598	15.1
Northern Connecticut Valley	2	156	20.2	45	28.8	0	0	45	28.8
Deerfield	3	217	6.8	59	27.2	0	0	59	27.2
Chicopee	21	4,517	16.6	1,197	26.5	160	3.5	1,357	30.0
Central Connecticut Valley	13	2,210	29.3	424	19.2	796	36.0	1,220	55.2
Westfield	13	1,457	18.7	139	9.5	325	22.3	464	31.8
Southern Connecticut Valley	4	677	24.0	325	48.0	0	0	325	48.0
Farmington	5	846	15.4	204	24.1	0	0	204	24.1
Totals	79	14,034	20.2	2,770	19.7	1,502	10.7	4,272	30.4

5.6 WATER SUPPLY

Communities in the Connecticut River Region meet their municipal water supply needs from local ground water or surface water supplies, except for Chicopee, South Hadley, and Wilbraham which purchase water from the Metropolitan District Commission. Many communities rely, to some degree, on private individual supplies to meet total community water needs. There are 31 towns which have no municipal water supply and, therefore, rely entirely on private individual supplies (Table 5.19).

Callahan Well - A newly developed municipal ground water supply in Hadley.

Hill Reservoir, located in Pelham, is part of the Amherst public water supply system.

TABLE 5.19 EXISTING MUNICIPAL WATER SUPPLY

Municipality	Ground Water	Surface Water	Safe Yield (MGD)	
Chicopee Study Area				
Barre	X	X	1.9	
Belchertown	X		0.4	
Brookfield		X	0.05	
East Brookfield	X		0.3	
Hardwick	X		0.7	
Hubbardston				1/
Ludlow		X		2/
Monson	X		1.3	
New Braintree				1/
New Salem				1/
North Brookfield		X	2.5	
Oakham				1/
Palmer	X	X	2.7	
Paxton		X	0.3	
Petersham				1/
Phillipston				1/
Rutland	X	X	0.5	
Spencer	X	X	2.0	
Ware	X		0.5	
Warren	X		1.6	
West Brookfield	X		1.0	
Southern Connecticut Valley Study Area				
Agawam		X		2/
East Longmeadow		X		2/
Hampden				1/
Longmeadow		X		3/
Springfield		X	62.5	
Wilbraham		X		4/
Westfield Study Area				
Becket				1/
Blandford		X	0.5	
Chester		X	0.3	
Chesterfield				1/
Cummington	X		0.03	
Goshen				1/
Huntington	X	X	0.4	
Middlefield				1/
Montgomery				1/
Peru				1/
Plainfield				1/
Russell	X	X	2.3	
Southwick		X		2/
Westfield	X	X	8.8	3/
West Springfield	X	X	5.0	
Windsor				1/
Worthington	X			
Farmington Study Area				
Granville	X		0.02	
Otis				1/
Sandisfield				1/
Tolland				1/
Millers Study Area				
Ashburnham		X	0.5	
Athol	X	X	0.4	
Erving				5/
Gardner	X	X	2.9	
Orange	X	X	1.3	
Royalston	X			6/
Templeton	X		0.8	
Warwick				1/
Wendell				1/
Winchendon	X	X	0.5	
Central Connecticut Valley Study Area				
Amherst	X	X	3.8	
Chicopee		X		3/7/
Deerfield	X	X	1.0	
Easthampton	X		2.5	
Granby	X		0.15	
Hadley	X		2.0	
Hatfield	X	X	0.4	
Holyoke	X	X	15.3	
Leverett				1/
Montague	X	X	2.3	
Northampton	X	X	11.4	
Pelham				1/
Shutesbury				1/
South Hadley	X	X		7/
Southampton	X	X	1.0	8/
Sunderland	X		0.3	
Westhampton	X	X	0.06	
Whatley	X		0.03	
Williamsburg	X	X	1.3	
Northern Connecticut Valley Study Area				
Bernardston	X		0.5	
Gill	X		0.05	9/
Northfield	X	X	0.6	
Deerfield Study Area				
Ashfield		X	0.03	
Buckland	X	X		10/
Charlemont				1/
Colrain	X	X	0.1	
Conway				1/
Florida				1/
Greenfield	X	X	3.3	
Hawley				1/
Heath				1/
Leyden				1/
Monroe		X		
Rowe				1/
Savoy				1/
Shelburne	X	X	1.1	10/

1/ Private individual supplies only. 2/ Supplied by Springfield. 3/ Partially supplied by Springfield. 4/ Supplied by MDC. 5/ Partially supplied by Millers Falls Fire and Water District. 6/ A small private water supply company. 7/ Partially supplied by MDC. 8/ Partially supplied by Holyoke. 9/ Partially supplied by Greenfield. 10/ Partially supplied by Shelburne Falls Water District.

Source: Massachusetts Water Supply Policy Study, January 1977
Massachusetts Executive Office of Environmental Affairs

5.7 IRRIGATION

Because the region has a well distributed rainfall of about 45 inches each year, little irrigating is done. Areas being irrigated are generally in high value crops including tobacco, commercial vegetables, small fruits, potatoes, and nursery stock. Few field crops require irrigation for successful production.

Census of Agriculture data indicates a total of about 1,000 acre-feet of water was used for irrigation in the Connecticut River Region in 1974. This is an average of less than 0.4 acre-foot per acre on the 2,700-acres irrigated on about 95 farms in the region.

Irrigation is not considered a problem area. The ongoing program of the Soil Conservation Service is assisting growers to install irrigation systems and implement other water management practices. Therefore, irrigation will not receive further consideration in this report.

5.8 DRAINAGE

Regionally, drainage of agricultural land is considered a minor problem. The Soil Conservation Service (SCS) is assisting farmers to install needed drainage systems. The Agricultural Stabilization & Conservation Service (ASCS) formerly provided cost sharing funds for drainage systems. For 1978, ASCS restricts cost sharing funds for drainage systems to just those systems which are used to control saline and/or polluted waters. It is expected that few, if any, proposed systems will qualify for such cost sharing funds in Massachusetts. In addition, assistance from SCS and ASCS is limited to lands not in Wetland Types 3 to 20, as defined in Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service. Therefore, drainage will not be discussed further in this report.

5.9 WATER QUALITY

According to the Massachusetts Division of Water Pollution Control, almost all of the major rivers in the region are effected to some degree by pollution. The most serious river water quality problem areas are:

1. The Millers River from Winchendon to the confluence with the Connecticut River;

2. the Otter River from Gardner to the confluence with the Millers River;

3. the Westfield River from Huntington to the confluence with the Connecticut River;

4. the Chicopee River from Palmer to the confluence with the Connecticut River;

5. the Ware River in Ware and Palmer;

6. the Connecticut River from the New Hampshire state line to the Connecticut state line.

Statements about existing poor water quality in the region are subject to revision as each new waste water treatment facility comes on line. Much has happened in the last 10 years to improve water quality: installation of new secondary treatment plants (some with advanced treatment), industrial waste water treatment (either tieups with municipal plants or treatment by the industry itself), and elimination of combined sewer problems.

At this time for much of the region, it is not known how much must be done beyond the levels of treatment presently being installed to meet the 1977 water quality requirements or the 1983 goals of Public Law 92-500, the Federal Water Pollution Control Act Amendments of 1972.

The Massachusetts Division of Water Pollution Control has established water quality standards for waters of the state[11/] (see Figure 5.14) and rated streams, using the following classification:

Class A - Waters designated for use as public water supply in accordance with Chapter III of the General Laws. Character uniformly excellent.

Class B - Suitable for bathing and recreational purposes including water contact sports. Acceptable for public water supply with treatment and disinfection. Suitable for certain agricultural and industrial uses. Excellent fish and wildlife habitat and aesthetic value.

Class B1 - The use and criteria for Class B1 shall be the same as for Class B with the exception of the dissolved oxygen criteria which is set lower than Class B.

Class C - Suitable for: recreational boating and secondary water contact recreation, habitat for wildlife and common food and game fishes indigeous to the region, certain agricultural and industrial uses. Under some conditions acceptable for public water supply with treatment and disinfection. Good aesthetic value.

Class C1 - The use and criteria for Class C1 shall be the same as for Class C with the exception of the dissolved oxygen criteria which is set lower than Class C.

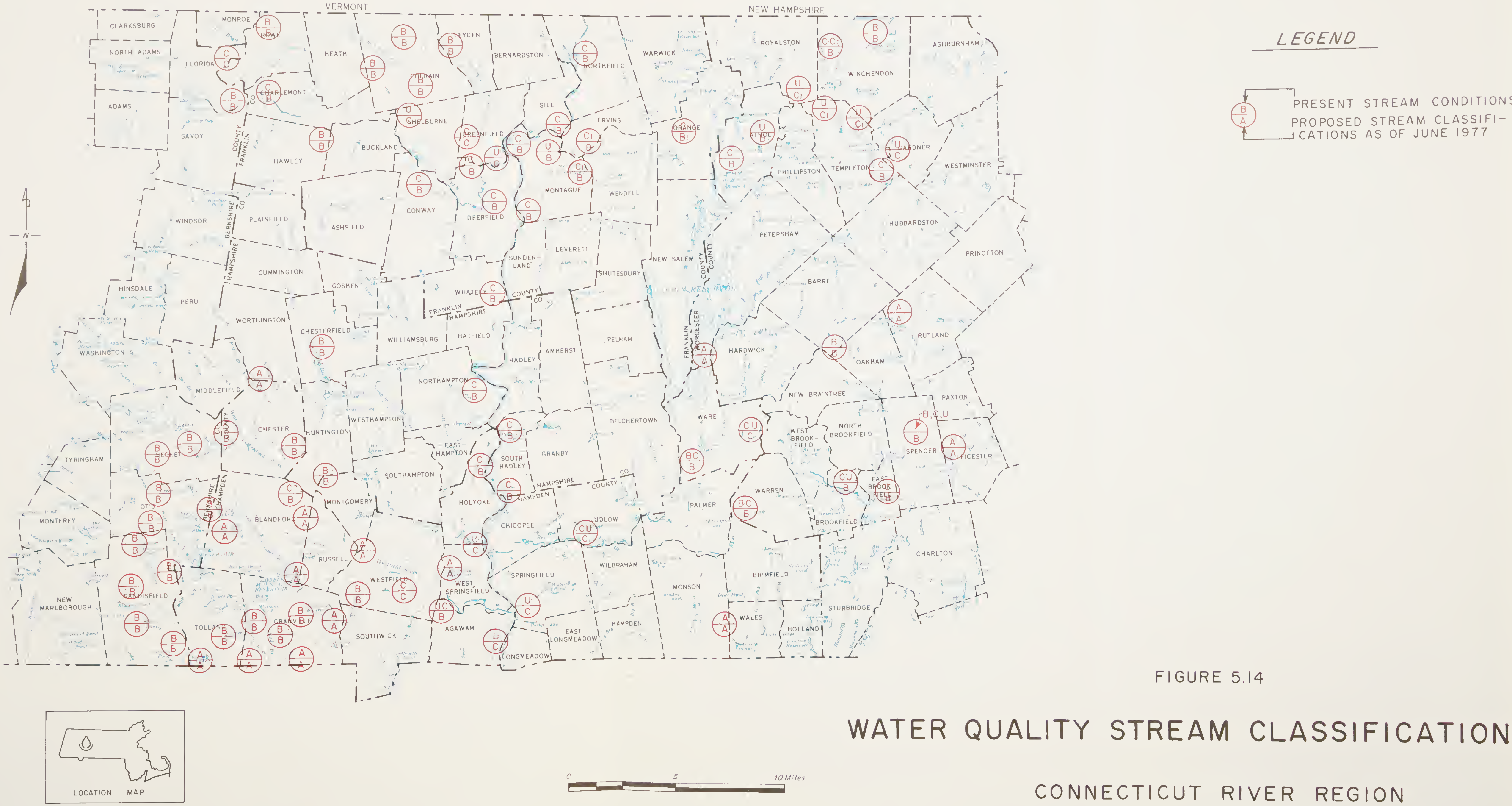


FIGURE 5.14

WATER QUALITY STREAM CLASSIFICATIONS

CONNECTICUT RIVER REGION

MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Class U[12/]- Unsatisfactory river conditions not capable of meeting "C" standards.

The Massachusetts Division of Water Pollution Control has developed a revised set of water quality standards, November 1977, which are presently being reviewed. For inland waters, the present Classes B1 and C1 will be dropped. Changes in stream segment classifications are proposed in these revised standards. For the Connecticut River Region, the proposed stream segment classifications are either Class B or A. This includes the stream segments classified as Class C in Figure 5.14.

Sources of water pollution are normally placed into two major categories: point or nonpoint sources.

Point sources are those where a large quantity of pollutants are discharged into a stream from a readily identifiable source. The most common examples of point sources include discharges from waste water treatment plants and industrial plants.

Nonpoint sources are more difficult to isolate. They usually involve relatively small quantities of pollutants which are discharged over relatively large areas. Examples of nonpoint sources include urban runoff such as salt runoff and litter from streets, animal wastes from livestock enterprises, sediment from accelerated erosion problem areas, fertilizer and pesticide runoff from agricultural use, effluent from inadequate septic systems, and leachate from poorly situated or managed landfills or dumps.

Individual onsite sewage disposal systems are relied on exclusively in many areas. Even in towns with some municipal sewer service, residents in outlying areas must make use of individual septic tank disposal systems.

In most cases, an adequately designed individual septic tank system is able to treat and dispose of domestic sewage with little adverse effect on the ground water. Unfortunately, many systems in the region are improperly designed and/or located. Also, septic systems usually do not remove significant amounts of nutrients such as phosphates and nitrates. An additional problem can be the adequate disposal of sludge from septic tank cleanouts.

In addition, soil conditions in much of the area are unsuitable for septic tank systems. Table 5.20 shows results extracted from special soil surveys prepared by the Soil Conservation Service for 28 of the region's cities and towns. Limitations shown are due to seasonal high water table, bedrock or hardpan, and low soil permeability. These are the most common limitations on the use of individual septic tank systems. Approximately 78 percent of the developable land in these towns has "severe" limitations for onsite septic tank disposal systems.

TABLE 5.20

LIMITATIONS FOR ONSITE SEPTIC TANK DISPOSAL SYSTEMS
(from Town Soil Reports)

City/Town	Area Mapped	Excluded Areas	Water	Unclassified	Total Classified	Limitation for Septic Tank System: Slight	Moderate	Severe	Percent of Classified Area with Severe Limitations
	Acres								
Chicopee Study Area									
Belchertown	35,562	5,430	1,881	187	28,064	3,572	3,303	21,189	75.5
Ludlow	18,227	3,347	375	570	13,935	4,223	3,200	6,512	46.7
Monson	29,003	0	208	420	28,375	1,541	2,026	24,808	87.4
Palmer	20,570	0	480	207	19,883	3,385	3,736	12,762	64.2
Paxton	9,856	0	512	24	9,320	95	13	9,212	98.8
Spencer	21,774	0	853	374	20,547	765	1,073	18,709	91.1
Warren	17,792	0	205	180	17,407	490	1,161	15,756	90.5
Westfield Study Area									
Blandford	33,924	8,249	1,198	76	24,401	52	86	24,263	99.4
Russell	11,420	0	285	107	11,028	506	193	10,329	93.7
Southwick	20,242	0	577	168	19,497	4,959	1,254	13,284	68.1
Westfield	30,419	5,500	521	624	23,774	8,687	1,206	13,881	58.4
West Springfield	11,134	0	439	4,615	6,080	1,246	237	4,597	75.6
Central Connecticut Valley Study Area									
Amherst	17,662	2,648	46	93	14,875	2,961	731	11,183	75.2
Deerfield	21,585	0	603	175	20,807	2,394	801	17,612	84.6
Granby	18,048	0	155	249	17,644	3,683	392	13,569	76.9
Holyoke	14,616	6,696	521	368	7,031	745	259	6,027	85.7
Montague	20,506	0	734	32	19,740	5,790	786	13,164	66.7
Northampton	23,360	706	1,267	1,589	19,798	2,220	435	17,143	86.6
Pelham	17,056	8,142	1,146	5	7,763	278	168	7,217	92.7
Southampton	18,898	2,459	538	113	15,788	2,960	943	11,885	75.3
Whately	13,325	0	180	13	13,132	1,789	445	10,888	82.9
Millers Study Area									
Winchendon	28,088	3,343	509	202	24,034	3,099	4,381	16,554	68.9
Southern Connecticut Valley Area									
Agawam	15,584	0	723	502	14,359	6,123	521	7,715	53.7
East Longmeadow	8,320	0	56	2,107	6,157	1,356	111	4,690	76.2
Hampden	12,608	0	51	127	12,430	1,505	771	10,154	81.7
Springfield	21,344	16,470	112	689	4,073	1,825	748	1,500	36.8
Wilbraham	14,406	0	95	521	13,790	3,244	553	9,993	72.5
Northern Connecticut Valley Study Area									
Northfield	22,554	0	717	75	21,762	2,141	945	18,676	85.8

Agriculture-related pollution usually results from two main sources: animal wastes and runoff containing residues of fertilizer, pesticides, and herbicides. In the Connecticut River Region, dairy cattle represent the largest potential source of animal waste pollution. Unless properly managed, animal wastes present a water quality hazard. Fertilizer which is not utilized by crops becomes a pollutant if washed into waterways, ponds, or lakes. The high cost of fertilizer and the relatively low-value of most crops tend to minimize fertilizer as a significant pollution source.

Forest management activities can also cause nonpoint pollution problems. This is true where such activities as recreation, timber management, grazing, road and trail construction, and timber harvesting occur. Certain water quality parameters, including water temperature, turbidity, total dissolved solids, nitrate-nitrogen, and fecal coliforms, may all be affected by the manner in which the watershed is managed. The significance is dependent on the particular management activities and the percentage of the watershed affected by the activities. Through proper planning, the adverse effects of forest land management on water quality can be minimized.

5.10 FISH AND WILDLIFE

5.10A Fish

Fishery resources in the Connecticut River Region include warm and cold water fish populations living in fresh water ponds, lakes, and streams and anadromous species which spawn in fresh water but spend part of their lives at sea.

The most sought-after game fish are the cold water species, the brook trout, which is native, and the introduced brown trout, lake trout, and rainbow trout. Many ponds and streams in the region are stocked with trout (See Tables 5.21 and 5.22). Artificial propagation and stocking are an attempt by the state to meet a continually growing angling demand. Trout do not reproduce effectively in most Massachusetts waters. They require cool waters with adequate levels of dissolved oxygen, conditions available year-round in very few streams. The heat of summer and pollution are major limiting factors.

Some of the better trout streams in the region are the Deerfield River, the Swift River, the Quaboag River, the Westfield River, the Ware River, and the Millers River above its confluence with the Otter River.

Warm water fishing in the region--and in the state as a whole--is not dependent upon artificial rearing and stocking. Bass, pickerel, and such panfish as white and yellow perch, bluegill, bullheads, and crappies can be caught. The present populations of panfish species could support more fishing pressure than they now receive.

Atlantic salmon and American shad are native anadromous species which are being restored to the Connecticut River system. They and other outstanding fishery resources in the region are discussed in Section 5.10B.

TABLE 5.21 SUMMARY OF STREAMS

Study Area	Miles of Streams	Number of Streams Stocked Annually with Trout
Deerfield	308	29
Northern Connecticut Valley	36	7
Millers	188	20
Westfield	290	26
Central Connecticut Valley	312	28
Chicopee	348	44
Farmington	113	6
Southern Connecticut Valley	35	3
Total	1,630	163

5.10B Outstanding Fishery Resources

Quabbin Reservoir

Quabbin Reservoir, filled in 1946, serves as a municipal water supply for metropolitan Boston and ten other communities in central and western Massachusetts. It also provides an outstanding fishery resource. The reservoir covers approximately 39 square miles in the valley of the Swift River in Franklin, Hampshire, and Worcester Counties.

Quabbin Reservoir has been managed for fish by the state since the early 1950s, and a number of cold water game fish species have been introduced. Lake trout were first stocked in 1952. Their numbers are maintained by natural reproduction. Between 20,000 and 40,000 rainbow trout are stocked each year, with little carry-over ("put and take," primarily). About 20,000 brown trout are stocked annually. The trout all seem to be doing well at present, their success resulting in large part from the smelt, which were introduced as forage for the predacious trout.

Smelt are also food for landlocked salmon, a game fish first introduced into Quabbin in the mid-1960s. The success of the salmon program was limited by insufficient numbers and poor quality of yearlings available for stocking.[13/] At present, there are few young fish available for stocking. The last sizable stocking of landlocked salmon took place in 1972.

TABLE 5.22 INVENTORY OF PONDS, LAKES, AND RESERVOIRS 20 ACRES OR GREATER IN SIZE

	Total No. of Ponds	Total Area (Acres)	Cold Water No.	Cold Water Acres	Warm Water No.	Warm Water Acres	Access: None-Private No.	Access: None-Private Acres	Access: None-Water Supply No.	Access: None-Water Supply Acres	Access: Municipal or Informal No.	Access: Municipal or Informal Acres	Access: Statewide No.	Access: Statewide Acres
County														
Worcester 1/2/	90	33,494	8	25,495	82	7,999	15	1,065	13	1,279	48	4,787	14	26,363
Franklin	26	1,494	8	494	18	1,000	3	89	3	167	12	882	8	356
Hampshire 2/	29	2,081	4	616	25	1,465	9	677	4	569	8	312	8	523
Hampden 2/	43	5,577	20	3,869	23	1,708	10	367	12	2,330	6	366	15	2,514
Berkshire 2/	30	1,991	4	230	26	1,761	14	585	1	30	4	490	11	886
Total	218	44,637	44	30,704	174	13,933	51	2,783	33	4,375	78	6,837	56	30,642
Study Area														
Deerfield	7	401	1	162	6	239	1	25	0	0	2	233	4	143
Northern Connecticut Valley	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Millers	47	4,267	7	428	40	3,839	6	543	5	556	29	2,737	7	431
Westfield	36	3,974	10	2,133	26	1,841	9	488	6	1,428	4	182	17	1,876
Central Connecticut Valley	26	2,023	9	990	17	1,033	4	320	10	922	9	660	3	121
Chicopee 1/	72	31,062	10	25,518	62	5,544	17	852	10	1,199	30	2,612	15	26,399
Farmington	24	2,603	6	1,437	18	1,166	14	555	2	270	2	358	6	1,420
Southern Connecticut Valley	6	307	1	36	5	271	0	0	0	0	2	55	4	252
Total	218	44,637	44	30,704	174	13,933	51	2,783	33	4,375	78	6,837	56	30,642

1/ Quabbin Reservoir is included in the Worcester County totals, although portions are in Franklin and Hampshire Counties.
2/ Only that portion of the county within the region is considered here.

Warm water fish are also present in Quabbin Reservoir. Approximately 30 percent of its volume is warm water habitat. Smallmouth bass is the primary warm water game fish. Other species include the yellow perch, white perch, largemouth bass, chain pickerel, bluegill sunfish, rock bass, and brown bullhead.

The proposed diversion of Connecticut River water into Quabbin via the Northfield Mountain Pumped Storage project would have an impact on the reservoir fishery. Although ozone treatment may be able to keep undesirable species from entering Quabbin, the introduction of the river water would, it is felt, in time cause changes in the limnologic characteristics of the reservoir. Some species could benefit, others not.[14/]

Northern Pike--Northern pike, a warm water species, was introduced into the Quaboag River and South Pond two years ago and is stocked there annually. There has been rapid growth but no evidence of reproduction.

Shortnose Sturgeon--The shortnose sturgeon, a fish classified as rare and endangered[15/] in Massachusetts and also endangered nationally[16/] is found in the Holyoke pool (between the Holyoke and Turners Falls dams) of the Connecticut River. The sturgeon population is thought to be self-sustaining and to exist in concentrations in two separate reaches of the river.[17/]

Anadromous Fish Restoration, Connecticut River--Since 1966, a cooperative fishery program for anadromous fish restoration in the Connecticut River Basin has been in operation. Involved are the fishery agencies from the states of Connecticut, Massachusetts, New Hampshire, and Vermont, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service. The goal of the program is to restore a run of two million American shad and forty thousand Atlantic salmon annually to the mouth of the Connecticut River.

Many obstacles must be surmounted, literally and figuratively, if that goal is to be reached and the salmon and shad runs are to approach their earlier strengths. Fish passage facilities must be constructed over three dams in Vermont and the Turner Falls Dam in Massachusetts. Phase I of a two-phase improvement project for fish passage of the Holyoke Dam has been completed with a resultant record passage in 1976 of 346,725 American shad. The Connecticut River Policy and Technical Committee has determined that, to be considered effective, the Holyoke facility must be capable of passing one million shad and 40,000 salmon. Construction of the fish passage facilities at the Turners Falls Dam is scheduled to begin in 1978 and be completed in 1980.

The American salmon had to be reintroduced to the Connecticut River because, unlike the shad, it has been unable to coexist with the dams. Approximately 660,000 juvenile salmon have been released into the

Connecticut system since 1967. In order for a run to become established, the adult fish must return upstream to spawn after an interval at sea. During 1977, seven adult fish were recovered from the Connecticut system; three were dead, four living. One of those is thought to be the first adult sea-run Atlantic salmon caught by a sport fisherman in the Connecticut system in over 100 years.[18/]

5.10C Wildlife

The Connecticut River Region of Massachusetts provides habitat for a variety of wildlife species, including those that are resident, migrants which are regular visitors, and others, such as the moose, which occasionally wander in. The number of different ecological niches available for the species to fill is related to the geographic location of the region and the physiographic variation within it. Ecosystem types range from the tilled cropland of the Connecticut River Valley bottom to the rocky, forested ledges of the Holyoke Range.

Where different species occur in the region is determined in large part by the use to which the land is put and by the resulting vegetative cover. Tables in Section 5.10E show acreages for various land uses and cover types in the Connecticut River Region and their associated plant and animal species. Trends in land use in the region emphasize the importance of efforts to retain or improve remaining wildlife habitat. That the habitat is not unbroken forest, unbroken, clean, tilled agricultural land or totally checkered by development is important for the retention of a varied animal population.

There are a number of species which exist in limited numbers in the state and in the region. The scarcity of some of them raises concern over the factors which are causing their declining numbers. Section 5.10F discusses scarce species and several locations within the region which are outstanding wildlife areas. These include the huge Quabbin Reservation, Mt. Tom, Lawrence Swamp, and the Quaboag Marshes.

5.10D Value and Use of Wildlife Resources

The greatest value of wildlife resources is the part each species plays in the natural system. Each has its role. Life as we know it depends on the adequate functioning of the whole, and knowledge of the interrelationships involved is still incomplete. Altering the size of wildlife populations by habitat modification or by other means can have unexpected consequences. A secondary value of wildlife is its recreational use by the human population. Wildlife is enjoyed in both nonconsumptive and consumptive ways.

Nonconsumptive--Nonconsumptive recreational uses of wildlife resources include bird watching, nature study, and wildlife photography. The Connecticut River Region provides a variety of habitat types in which wildlife may be observed and photographed. The wildlife management areas of the Massachusetts Division of Fisheries and Wildlife are popular locations for observing animals. The areas receive that type of use in all seasons, while their use for hunting is limited to relatively short periods. Quabbin Reservation provides over 100 square miles for the observation and study of wildlife. Other popular areas for the nonconsumptive enjoyment of animals are wetlands, such as Lawrence Swamp in Amherst and marshes along the Quaboag River, and the oxbows and meanders of the Connecticut River.

Consumptive--Approximately 2.4 percent of the Massachusetts population participates in hunting game species in the Commonwealth. Huntable game species for which there are specific season lengths and daily and seasonal bag limits include white-tailed deer, black bear, snowshoe hare, cottontail rabbit, gray squirrel, opossum, raccoon, red and gray fox, bobcat, pheasant, ruffed grouse, woodcock, and waterfowl. In addition, house sparrow, chipmunk, flying squirrel, red squirrel, weasel, porcupine, striped skunk, and woodchuck are not protected and may be hunted at any time of the year. Crows are protected for 241 days of the year and may be legally hunted during the remainder. Of the 94-towns in the Connecticut River Region, only eight have ordinances which restrict hunting.

Statewide hunter preferences for various game species,[19/] in descending order of importance, with notes on habitat and numbers, are, as follows:

> Pheasant--Large areas of agricultural land well interspersed with brush land, swamps, and small woodlots. Pheasant hunting is enhanced by annual releases of cock pheasants by the Massachusetts Division of Fisheries and Wildlife and by private sporting clubs. There is some natural reproduction in the Connecticut River Valley itself, but comparatively little in the region overall. Hunting success is greatly dependent upon stocking. The ring-necked pheasant was first introduced into Massachusetts in 1894.
>
> Deer--Forest land in various stages of succession, interspersed with swamps and open land. The reversion (through natural succession) of open land to woodland in the region along with the proliferation of development have decreased the amount and quality of available deer habitat. Thus, populations in the region are not great. Highest numbers can be found in the western portion of the region.

Ducks and geese--Wetlands, permanent open waters. The Connecticut River Region, located inland as it is, is not exceptional for waterfowl hunting. The "hot spot" in the region is the Connecticut River itself, particularly meandering oxbows, and locations at the confluence of major tributaries. Other less important locations are old meander ponds of the Deerfield River, the Quaboag River marshes, and the many beaver flowages in the headwater areas. Members of a duck hunters' club in the western part of the state have built, erected, and maintained about 300 nesting boxes for wood ducks.

Ruffed grouse--Forest land, particularly in the early stages of succession, well interspersed with old fields, orchards, and swamps. Hunting for ruffed grouse in the region could be considered "fair".

Cottontail rabbit--Agricultural land well interspersed with brush land, hedgerows, swamps, and small woodlots. Cottontail rabbit and gray squirrel are the most available and most widely utilized small game animals in the region.

Woodcock--Early succession woodland and moist areas containing much alder and aspen and fairly clear of heavy ground cover. The region offers generally fair woodcock hunting.

Gray squirrel--Hardwood forest containing mature oak and hickory trees. Gray squirrels are common and are becoming increasingly utilized.

A much smaller proportion of Massachusetts residents engage in trapping than in hunting, though the number of trappers increases as fur prices rise. Beaver, muskrat, otter, raccoon, mink, opossum, fox, skunk, weasel, bobcat, and fisher may be trapped. Bobcat and fisher are uncommon in the region.

The future of wildlife in the Connecticut River Region, as elsewhere, is dependent upon wise management and consideration of wildlife needs in decisions which affect land use. The effects of a development upon habitat must be evaluated.

Other aspects of our civilization must be examined. Trail bikes ridden cross country can destroy ground cover. Snowmobiles can crush seedlings and create trails of packed snow which dogs can follow to chase deer. Many deer fall prey to dogs each winter. Habitat can and should be managed for those species in jeopardy and for those species with high sporting or aesthetic values. As a fresh meadow wetland succeeds to brushy thicket and later to woodland, the habitat for bobolink is lost. Similarly, as fresh meadows, hayland and pasture fields revert to woodland and the existing woodland matures, deer habitat

quality decreases with a resulting reduction in the number of deer. Through habitat management and a concerned citizenry, the habitat of the bobolink, the deer and most other species of wildlife could be improved, or at least maintained.

5.10E Land Uses and Vegetative Cover

Wildlife populations in an area are intimately related to the land use and vegetative cover. Different species have different habitat requirements for food, water, protective cover, and nesting or resting sites which must be satisfied within their daily and annual ranges, if the animals are to survive. Wildlife resources in the Connecticut River Region include forest species, wetland species, and open land or agriculturally related species. There are also some species which can live in urban and suburban environments. Table 5.23 gives the acreages of the present land use and vegetative cover types in each of the study areas of the Connecticut River Region. Table 5.24 lists the vegetation and wildlife associated with the more important cover types in the region.

About 71 percent of the Connecticut River Region is upland forest. The forest wildlife habitat may be composed primarily of hardwood trees, softwood trees, or a combination of both. The forest stand, of whichever type, can vary in age, in height, in density, and in the associated understory and ground cover vegetation. Those differences all affect the types and numbers of wildlife present.

Classed as "open land wildlife" are those species which prefer open agricultural land or land which has recently been abandoned that is beginning to revert to woodland through natural plant succession. The category "agricultural land" includes tilled or tillable cropland, hayland, pasture, orchards, nurseries, and greenhouses. "Abandoned agricultural land" includes abandoned fields and orchards in some stage of plant succession in which grasses, forbs, and shrubs are still found. About 13 percent of the Connecticut River Region is in agriculture or abandoned agriculture.

Wetlands comprise about 7 percent of the region. Of the different types of wetlands, "open fresh water" (type 5)[20/] covers the most area. Open fresh water may produce aquatic vegetation of high value to waterfowl. It provides food and cover for muskrat, beaver, and otter, and food for mink and raccoon. The other wetland types are listed below in order of decreasing total area, with notes about their importance to wildlife.

Wooded Swamps (type 7)--Provide high value food and cover to woodcock, cottontail rabbit, snowshoe hare, and deer and are important as nesting and feeding areas for wood and black ducks when the swamp borders open water.

TABLE 5.23

LAND USE AND VEGETATIVE COVER[1/]

	Study Area									
	Deerfield	Northern Connecticut Valley	Millers	Westfield	Central Connecticut Valley	Chicopee	Farmington	Southern Connecticut Valley	Total	Percent of Region
	Acres									
Urban	7,494	1,758	12,641	19,840	37,036	19,461	2,336	27,692	128,258	7.3
Hardwoods	57,039	3,921	17,733	89,583	49,094	102,675	37,053	10,084	367,182	20.9
Softwoods	14,223	1,321	14,625	10,273	15,461	20,767	5,837	1,213	83,720	4.8
Mixed Hardwood & Softwood	122,689	27,566	135,367	152,245	115,023	183,036	45,969	19,494	801,389	45.7
Agriculture	26,300	8,702	10,649	23,301	51,079	45,828	3,086	8,801	177,746	10.1
Abandoned Agriculture	8,926	1,085	4,426	10,089	8,934	17,484	2,057	3,158	56,159	3.2
Power Lines	2,039	295	963	1,237	1,791	2,239	247	370	9,181	0.5
Wetland Types[2/3/]										
Wetland Types 1 & 2	475	59	966	827	1,388	1,638	569	97	6,019	0.3
Wetland Types 3 & 4	802	92	2,257	1,883	1,208	3,986	1,849	53	12,130	0.7
Open Fresh Water, Type 5[4/]	533	45	4,066	4,086	3,356	29,978	3,864	521	46,449	2.6
Wetland Types 6 & 8	435	208	2,166	882	702	3,277	500	275	8,445	0.5
Wetland Type 7[5/]	1,460	412	9,409	4,189	4,254	18,302	2,584	2,399	43,009	2.5
Total Wetlands	(3,705)	(816)	(18,864)	(11,867)	(10,908)	(57,181)	(9,366)	(3,345)	(116,052)	(6.6)
Sand	18	0	0	32	76	7	0	4	137	0
Exposed Rock	0	0	0	0	22	0	58	0	80	0
Recreation	630	151	838	1,636	2,775	1,169	74	1,985	9,258	0.5
Mining or Waste Disposal	387	223	721	1,054	1,460	1,273	128	574	5,820	0.3
Totals	243,450	45,838	216,827	321,157	293,650	451,120	106,211	76,720	1,754,982	

1/ Based primarily on information provided by W. P. MacConnell et al., Remote Sensing 20 Years of Change, Massachusetts Agricultural Experiment Station, University of Massachusetts at Amherst, 1974.

2/ Shaw, S. P. and C. G. Fredine, Wetlands of the United States, Circular 39, Fish and Wildlife Service, U.S. Department of the Interior, U.S. Government Printing Office, Washington, D.C., 1971.

3/ The categories presented here are:
- Type 1 - Seasonally flooded basins or flats
- Type 2 - Inland fresh meadows
- Type 3 - Inland shallow fresh marshes
- Type 4 - Inland deep fresh marshes
- Type 5 - Inland fresh open water
- Type 6 - Shrub swamps
- Type 7 - Wooded swamps
- Type 8 - Bogs

4/ Acreages derived by subtracting river areas from MacConnell's figures for open water.

5/ Wooded swamps could not be distinguished in MacConnell's analysis of aerial photography. These figures were derived by measuring areas marked by the swamp symbol on topographic maps in areas designated as forest by MacConnell.

TABLE 5.24

LAND COVER AND ASSOCIATED VEGETATION AND WILDLIFE

Land Cover Type	Acres	Percent of Land in Region	Vegetation Associated With Cover Type Trees/Woody Plants	Understory Plants/Nonwoody Plants	Wildlife Associated with Cover Type: Mammals	Birds	Reptiles, Amphibians
Hardwood	367,200	20.9	northern red oak white oak red maple sugar maple American beech white ash black cherry basswood yellow birch shagbark hickory	serviceberry witch hazel arrowwood hobblebush wild raisin maple-leaved viburnum alternate-leaved dogwood sarsaparilla	eastern chipmunk raccoon striped skunk opossum whitetail deer white-footed mouse shorttail shrew hairytail mole starnose mole gray squirrel	ruffed grouse blue jay screech owl crow black-capped chickadee slate-colored junco	spring peeper eastern garter snake northern black racer eastern mile snake American toad
Softwood	83,920	4.8	eastern hemlock red spruce balsam fir	honeysuckle witch hazel mountain laurel	red squirrel northern flying squirrel eastern chipmunk shorttail shrew starnose mole white-footed mouse opossum whitetail deer	black-capped chickadee downy woodpecker hairy woodpecker white-breasted nuthatch blue jay slate-colored junco starling crow	
Mixed Hardwood and Softwood	801,400	45.7	northern red oak white oak red maple sugar maple eastern hemlock white pine shagbark hickory	honeysuckle silky dogwood raspberry	red squirrel northern flying squirrel gray squirrel eastern chipmunk eastern cottontail raccoon striped skunk opossum	ruffed grouse black-capped chickadee downy woodpecker hairy woodpecker blue jay slate-colored junco crow	spring peeper eastern garter snake northern black racer eastern milk snake American toad red-backed salamander
Wetland - Fresh Water	116,100	6.6	speckled alder red maple black ash	steeplebush meadowsweet arrowwood witherod poison sumac black chokeberry highbush blueberry reed canarygrass reeds sedges grasses cattail	muskrat mink beaver otter little brown myctis	wood duck black duck mallard duck catbird cedar waxwing woodcock tree swallow	spring peeper wood frog bull frog leopard frog green frog eastern garter snake northern black racer spotted turtle eastern painted turtle eastern box turtle wood turtle spotted salamander red-back salamander

TABLE 5.24 - cont. LAND COVER AND ASSOCIATED VEGETATION AND WILDLIFE

Land Cover Type	Acres	Percent of Land in Region	Vegetation Associated With Cover Type Trees/Woody Plants	Understory Plants/Nonwoody Plants	Wildlife Associated with Cover Type: Mammals	Birds	Reptiles, Amphibians
Open Land - Agricultural	177,700	10.1	trees grown include domestic fruit trees, ornamental trees and shrubs, and Christmas trees	crops and forage grown include silage, corn, vegetables, shade-grown tobacco, alfalfa, and grasses	meadow vole shorttail shrew starnose mole woodchuck whitetail deer striped skunk	goldfinch meadowlark field sparrow mourning dove ring-necked pheasant red-winged blackbird cowbird starling	eastern garter snake American toad
Open Land - Abandoned Agricultural	56,200	3.2	silky dogwood gray dogwood pasture juniper red maple gray birch highbush blueberry lowbush blueberry	goldenrod milkweed hawkweed fescue timothy orchard grass	eastern cottontail red fox striped skunk woodchuck eastern chipmunk whitetail deer shorttail shrew meadow vole	goldfinch red-winged blackbird cowbird ring-necked pheasant mourning dove starling ruffed grouse	eastern smooth green snake eastern garter snake eastern milk snake northern black racer American toad
Urban	128,300	7.3	ornamental trees	grasses ornamental herbs and shrubs	Norway rat house mouse gray squirrel shorttail shrew eastern mole	rock dove starling English sparrow nighthawk grackle	American toad brown snake
Power Lines	9,200	0.5	trees which do not interfere with primary land use	grasses low shrubs	eastern cottontail	ruffed grouse rufous-sided towhee slate-colored junco	eastern garter snake
Recreation	9,300	0.5					
Mining or Waste Disposal	5,800	0.3					

Seasonally Flooded Basins or Flats (type 1) and Inland Fresh Meadows (type 2)--Seasonally flooded areas are utilized by waterfowl for feeding when flooded; fresh meadows are used as feeding grounds and for nesting with favorable conditions. Both types provide food for deer during summer and fall, year-round food for fox, skunk, weasel, and raccoon, and food and cover for pheasant especially during winter.

Inland Shallow Fresh Marshes (type 3) and Inland Deep Fresh Marshes (type 4)--Shallow fresh marsh is a very important type, used by waterfowl for nesting and feeding; deep fresh marsh is the most important inland type--it is used for feeding and, in some cases, nesting, by waterfowl; both types provide food and/or cover for muskrat, mink, and a variety of other species.

Shrub Swamps (type 6) and Bogs (type 8)--Important to waterfowl when they border permanent open water; shrub swamps provide high value food and cover to wood duck, cottontail, hare, and deer, food and/or cover to other species.

Kinds of plants found in wetlands in the region vary widely, depending on the depth of water, period of flooding, and stage of plant succession.

Nearly all types of land and uses of land support some wildlife species. Edge between each different type of cover--field, forest, or wetland--is extremely valuable to wildlife because it provides variety and food and cover in close proximity.

Land uses and vegetative cover are not static. Changes occur both with and without human action, and those changes can drastically alter the size and composition of wildlife populations.

Natural succession gradually changes vegetative cover, moving it in stages toward the climax condition for the particular location. Abandoned agricultural fields grow up into young forest. Young forest matures and ages to become old forest. Without some intervention, such as fire, timber harvest, or some sort of land clearing, natural succession effectively eliminates open land and, concomitantly, eliminates those wildlife species which require or prefer open land. In addition, as lands become increasingly forested, diversity is reduced. This progression toward unbroken forest is one major trend in Massachusetts today.

Working in opposition to that trend is another, man-caused trend toward the development of all lands easily built-upon for residential, commercial, and industrial uses. Those easily built-upon lands are often agricultural or abandoned agricultural lands. In Hampshire County, agricultural and open lands dropped from 24 percent of the

county to 18 percent in the period 1952 to 1972, while all urban uses increased.[21/] Where urban-type development occurs, open land habitat is virtually eliminated.

If Massachusetts is to retain or increase the numbers and variety of wildlife species which it now supports, efforts must be made to provide the necessary variety and area of suitable habitat. Preservation of farmland and more active timber harvesting programs are two important means toward retaining variety. Habitat area is often best retained through public or quasi-public ownership. Ownership should be coupled with management, however, if habitat diversity is to be provided. This insures that what is open space today will continue to be open space in years to come.

5.10F Outstanding Wildlife Resources

Quabbin Reservation--The Quabbin Reservation includes Quabbin Reservoir with an area of about 39 square miles, and that portion of its watershed, about 159 square miles, which is owned by the Metropolitan District Commission.

By Act of the General Court of Massachusetts, during the session of 1972, it was directed that the "natural ecology of the district shall be maintained, and it shall be conserved in its present degree of wilderness character and shall be protected in its flora and fauna in all reasonable ways to assure the balanced wildlife habitat..."[22/]

Thus, wildlife on the vast reservation are able to live relatively unmolested by man and can populate an area with a quite varied habitat. A number of uncommon species may be found there: river otter, bobcat, wild turkey (reestablished), and our national symbol, the bald eagle. At least 12 bald eagles wintered there in 1976-1977. There were at least 25 during the 1950s, but then the number fell to three by 1970.[23/]

Wild turkeys were plentiful in Massachusetts during colonial times but were extirpated in the state by 1851 when the last reported bird was shot on Mt. Tom. Efforts to restore the wild turkey began in 1960 with the Massachusetts Division of Fisheries and Wildlife and the Massachusetts Cooperative Wildlife Research Unit cooperating. The first birds to be stocked were released on the Prescott Peninsula of the Quabbin Reservation, and birds are now found there and in other areas.

The Quabbin Reservation has proven extremely valuable as an area where wildlife research can be conducted. The bobcat is one species which has been studied. Knowledge gained about the needs and behavior of species increases the success of management efforts throughout the state.

Mt. Tom - Hawk Migrations--Hawks from the central parts of northern New England funnel together when migrating south in the fall. They ride the updrafts of the Holyoke Range, which lies on an east-west axis across the Connecticut River Valley, and move in processions past Mt. Tom. Great numbers of different hawk species can be seen from the mountain in a single day. In a reversal of their fall journey, the migrants move north past Mt. Tom in the spring.

Lawrence Swamp--Lawrence Swamp is an 800-acre wetland located in the towns of Amherst and Belchertown. The swamp provides valuable habitat for a variety of wetland wildlife species and many song birds.

Quaboag Marshes--The Quaboag marshes are a wetland area of regional significance which borders the Quaboag River as it runs northwest from Quaboag Pond. The marshes encompass about 1,080 acres in the towns of Brookfield and West Brookfield in Worcester County.

The Quaboag marshes retain flood waters and provide extremely valuable wetland wildlife habitat. The 890-acre Quaboag Wildlife Management Area (Massachusetts Division of Fisheries and Wildlife) includes part of the marsh. The remainder is in private ownership. Ducks, geese, deer, raccoon, rabbit, fox, hawks, owls, muskrat, and mink are among the wildlife species which utilize the marshes. The marshes are popular for waterfowl hunting and are heavily used.

Species Existing in Limited Numbers--Table 5.25 lists wildlife species existing in limited numbers in the state which are found in the Connecticut River Region. One's likelihood of observing any of these species is small, but their continued existence is important.

Several of the listed species are believed to be declining in numbers. One of these, the eastern bluebird, is believed to suffer from habitat decline, from the effects of pesticides, and from competition for nesting sites.[15/] Acid rain (a consequence of air pollution) is thought to be detrimental to the reproduction of the spotted and the marbled salamander and a factor in their decline.[24/]

The state ornithologist considers nine bird species which are local, annual nesters in the region[25/] to be rare. (Inclusion in this list confers no special legal status.) These species and their known nesting locations in the Connecticut River Region are, as follows:

Common loon - Quabbin Reservoir only.

Great blue heron - a very few scattered rookeries, one in Wendell; one in Hawley; these breeding concentrations have historically been victims of vandalism.

TABLE 5.25 WILDLIFE SPECIES EXISTING IN LIMITED NUMBERS IN MASSACHUSETTS WHICH ARE FOUND IN THE CONNECTICUT RIVER REGION[1/]

Species	Distribution	Estimated Numbers	Typical Habitat	Status[2/]
Mammals				
Eastern Cougar	Inconclusive, unverified sight reports from central and western Massachusetts.	If present, cannot be more than a few.	Isolated mature or second growth woodlands and mountainous areas.	Endangered
Eastern coyote	Berkshire, Franklin, Hampden, Hampshire, and northern Worcester Counties.	Probably several hundred.	Rural, wilderness areas of second and third growth woodlands interspersed with farm lots, swamps, and country roads.	Undetermined
Moose	Occasional stragglers range into northeastern, central, and western parts of the state.	None resident, regular stragglers appear almost annually.	Wilderness areas of early successional mixed stands interspersed with bog and shallow ponds.	Peripheral
Indiana bat	Scattered western Massachusetts locations.	Unknown, but probably few.	Limestone caves, subterranean excavations, hollow trees, houses, beneath bridges.	Endangered
Birds				
Southern bald eagle	Migrates regularly at Mt. Tom; summer visitants at Quabbin Reservation; irregulars statewide.	No breeders. A few have wintered at Quabbin Reservation since 1950.	Isolated woodlands near large bodies of water, coastal and interior.	Endangered
American peregrine falcon	Rare transient in the state, especially coastal areas.	Extirpated as a nester; rare transient, usually less than a dozen annually.	Nests on high cliffs or ledges, frequently overlooking water bodies or valleys.	Endangered
Eastern bluebird	Transient statewide, limited breeding, especially in Connecticut Valley; nests fairly regularly around beaver ponds of Quabbin Reservation.	Unknown	Open woods, swamps, rural roadsides, farmland, burnt over areas.	Undetermined
Golden eagle	Irregulars statewide. Winter visitants at Quabbin Reservation.	No breeders. A few winter at Quabbin Reservation.	Nests on high cliffs or in large trees in mountainous remote areas.	Rare
Reptiles				
Eastern box turtle	Statewide, except mountainous regions.	Unknown	Fields, meadows, open woodlands, usually near water.	Undetermined
Timber rattlesnake	Scattered colonies in southern Berkshire, Hampden, and Hampshire counties and Blue Hill Reservation, Norfolk County.	Unknown	Rocky field, woodlands, and mountainsides.	Endangered

TABLE 5.25 - cont. WILDLIFE SPECIES EXISTING IN LIMITED NUMBERS IN MASSACHUSETTS WHICH ARE FOUND IN THE CONNECTICUT RIVER REGION1/

Species	Distribution	Estimated Numbers	Typical Habitat	Status2/
Reptiles - cont.				
Northern copperhead	Blue Hill Reservation, Norfolk County, Connecticut River Valley between Greenfield and Springfield and southern Berkshire County.	Unknown	Rocky, wooded hillsides, often moving to bottomlands near water during summer.	Undetermined
Black rat snake	South-central Massachusetts, east to Webster, west to Westfield. north to Sunderland.	Unknown	Wooded uplands, hillsides, forest edges.	Undetermined
Eastern worm snake	Hampden County in vicinity of Connecticut River.	Unknown	Lowlands, burrows in soft moist earth, found under boards, slabs, stones, and logs.	Undetermined
Amphibians				
Spotted salamander	Statewide, except offshore islands.	Unknown	Lives underground in moist woodland.	Threatened
Marbled salamander	Principally throughout Worcester County and eastward, with remnant colonies in Middlesex, Plymouth, and Bristol Counties.	Unknown	Woodlands.	Threatened
Jefferson salamander	Connecticut River Valley.	Unknown	Lives underground in moist woodland.	Undetermined
Four-toed salamander	Scattered from Connecticut River Valley eastward to Cape Cod.	Unknown	Swamps, sphagnum bogs, acidic meadows.	Undetermined

1/ From "An Inventory of Massachusetts Fish and Wildlife (vertebrate) Resources," by P. S. Mugford, Massachusetts Division of Fisheries and Wildlife, Boston, 1975.

2/ Rare - Not immediately in peril and possibly stable at present, but existing in such low numbers or with such a restricted distribution that the entire species population could be seriously jeopardized by catastrophic events occurring within its range. Endangered - In immediate danger of extinction or extirpation from the state due to critically low or drastically declining populations brought about by habitat modification, overexploitation, pollution, diseases, or other factors. Undetermined - Not in immediate danger of extinction or extirpation but showing signs of decline and causing justifiable concern; or being little known or apparently uncommon and possibly could be jeopardized by inadvertent actions. More information required to properly evaluate status. Peripheral - Reaches the limit of its usual range outside Massachusetts. Occasional individuals or stragglers may be found but no breeding populations within the state. Threatened - Likely to become an endangered species in the foreseeable future throughout all or a significant portion of its range.

American bittern - limited to suitable marsh habitat; known to nest at Windsor, Blandford, Granby, North Orange, and Warwick.

Wild turkey - Prescott Peninsula, Quabbin Reservation.

Upland sandpiper - Hadley, Agawam, Westover Air Force Base.

Worm-eating warbler - Known to nest only at the Mt. Tom State Reservation.

Golden-winged warbler - Nests in scattered, variable locations from year to year.

Mourning warbler - Savoy State Forest and possibly a few other breeding stations in the northwestern section of the region.

Grasshopper sparrow - Sunderland, Westfield, Westover Air Force Base; occasional elsewhere in sporadic colonies.

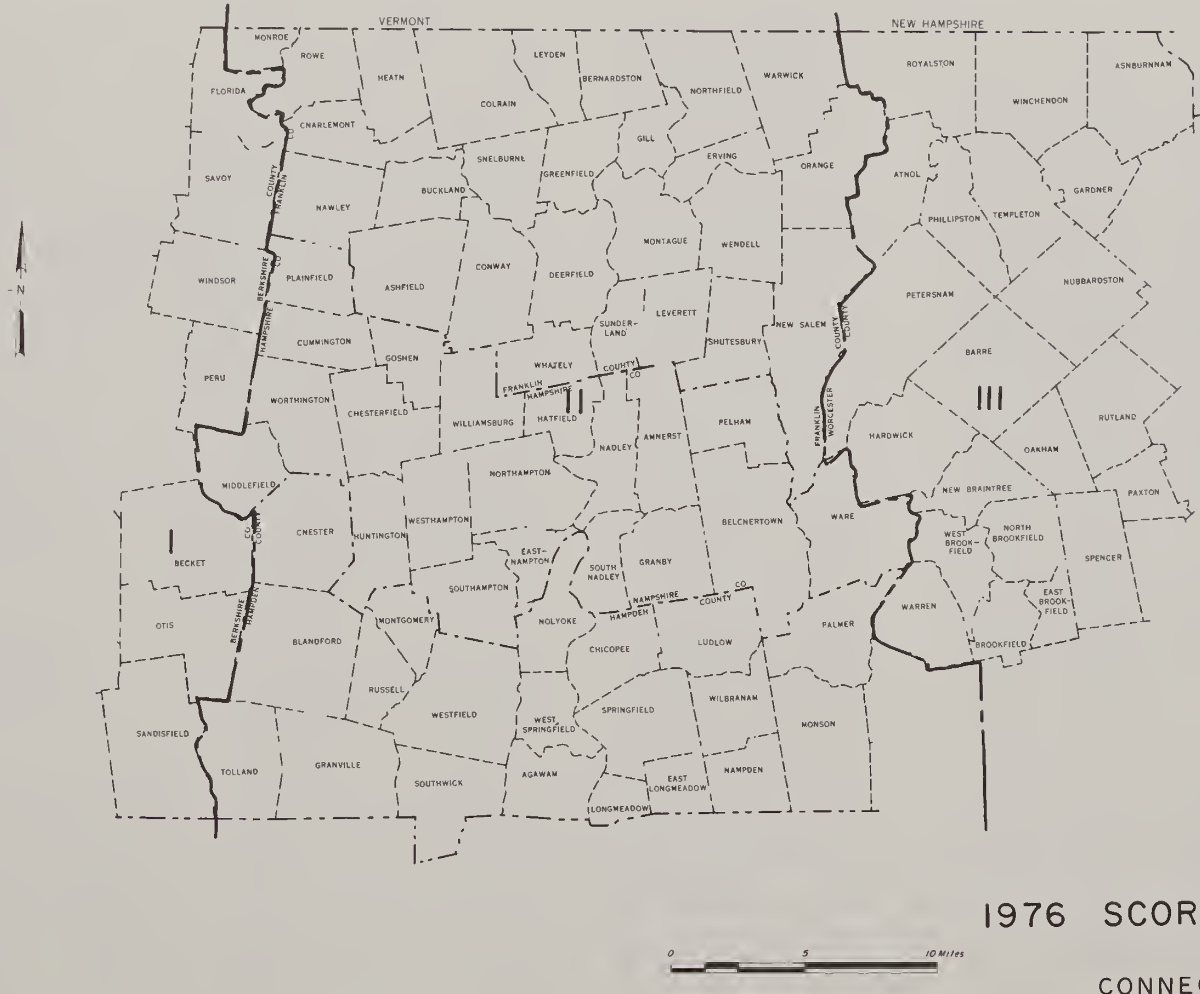
5.11 RECREATION

The analysis made in this study of recreation supply, demand, needs, and alternatives has been limited to those outdoor recreation activities which are water-related or which are normally assumed to be enhanced or complimented by adjacent water bodies. These activities include swimming, camping, picnicking, canoeing, sailing, and hiking. The primary data source was the 1976 Statewide Comprehensive Outdoor Recreation Plan (SCORP) prepared by the Massachusetts Department of Environmental Management.

The available supply of recreation resources was obtained from figures for SCORP Regions I, II and III (Figure 5.15), adjusted to fit the Connecticut River Region. The supply figures (Table 5.26) give a good indication of the extent of outdoor recreation available in the region.

TABLE 5.26 SUPPLY OF SELECTED RECREATION ACTIVITIES

Activity	Supply (1000 Activity Days)
Swimming	7,127
Camping	626
Picnicking	1,966
Canoeing-Sailing	3,172
Hiking	1,247



LEGEND

I	BERKSHIRE
II	CONNECTICUT VALLEY
III	CENTRAL HIGHLANDS

FIGURE 5.15

1976 SCORP PLANNING REGIONS

CONNECTICUT RIVER REGION
MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

In addition to the recreation resources that can be quantified by the activity days that they provide, the region boasts a number of "landscape and natural areas" which provide opportunities for passive recreation and enjoyment. These areas which have been identified in the 1974 Massachusetts Landscape and Natural Areas Survey include natural areas with scenic, historic or scientific significance. Of the total of 100 of these natural areas located in the region, 53 are owned by public agencies, private conservation organizations, or institutions. Forty-seven of the natural areas are wholly or partially owned by private individuals. Ownership of the natural areas is quite important in providing public access to enjoy the resource. The vulnerability of the area to disruption and even possible loss through development is also dependent upon ownership and owner attitude. In some cases, publicly owned areas are in jeopardy while some privately owned areas are safe and zealously protected by the owner.

The region's historic, aesthetic and cultural attractions include Old Deerfield Village, adjacent to Deerfield Academy in the town of Deerfield, and the Mohawk Trail, a 42-mile scenic highway from Greenfield to North Adams. The views of the Connecticut River flowing through its flat, fertile flood plain agricultural lands, from such vantage points as Mt. Sugarloaf in Deerfield and Mt. Holyoke in Hadley and South Hadley have long attracted tourists.

The Five College Association of Amherst College, University of Massachusetts, Hampshire College, Smith College, and Mount Holyoke College, and the city of Springfield provide many educational and cultural events and entertainments for the people of the region. In addition, numerous historic inns, homes, and other buildings are a reminder of the region's vivid history. The region has approximately 45 properties listed in the National Register of Historic Places. Of these, six have been designated as National Historic landmarks.

The Connecticut River and its major tributaries provide enjoyable canoeing and boating. One of the more popular canoe trips in New England consists of canoeing the river from near the Canadian border to Long Island Sound. As water quality improves in the region, an increase in recreational use of the rivers is expected.

The 1976 SCORP report identifies several rivers which should be considered for protection under the Scenic and Recreational Rivers Act, Chapter 21, Section 17B of the Massachusetts General Laws. These river reaches are essentially the same as those identified in the Connecticut River Basin Study reports published in 1970. This 1970 listing was developed by United States Department of the Interior, Bureau of Outdoor Recreation, who suggested that state programs would be more suitable for the Connecticut River Basin than would the federal Wild and Scenic Rivers Program. The SCORP listing is included in Table 5.27.

TABLE 5.27 POTENTIAL SCENIC AND RECREATIONAL RIVERS

Study Area	River	Section of River
Deerfield	Deerfield River	- Fife Brook to Charlemont - Dam #2 to Stillwater Bridge
	South River	- Source to mouth
	East Branch - North River	- State line to mouth
	North River	- Source to mouth
	Green River	- State line to water supply dam - Water supply dam to mouth
Millers	Millers River	- Winchendon to mouth
	Tully River	- Source to mouth
Central Connecticut Valley	Sawmill River	- Lake Wyola to mouth
	Fort River	- Pelham Road to mouth
	Manhan River	- Southampton to mouth
Chicopee	Chicopee River	- Three Rivers to Ludlow
	East Branch Swift River	- Brown's Pond to Quabbin Reservoir
	Swift River	- Quabbin Reservoir to mouth
	Burnshirt River	- Stone Bridge Pond to mouth
	East Branch - Ware River	- Mare Meadow Reservoir to Barree Falls Reservoir
	Ware River	- Barre Falls Reservoir to Rte. 122 - Barre Plains to Thorndike
	Quaboag River	- Quaboag Pond to Palmer
Westfield	Westfield River	- Swift River to Knightville - Knightville Dam to West Springfield
	Middle Branch-Westfield River	- West Worthington to Littleville Reservoir
	West Branch-Westfield River	- Becket to Huntington
	Westfield Little River	- Cobble Mt. Reservoir to Substation - Water Works to Northwest Road
Southern Connecticut Valley	Scantic River	- Hampden to state line
Farmington	West Branch - Farmington River	- North Otis to New Boston
	Clam River	- Source to mouth
	Buck River	- Source to mouth

Source: 1976 SCORP Report

There are 218 ponds and lakes of 20 acres or over in size located within the region. These provide more than 44,000 acres of surface water. These bodies of water are used for municipal water supply, fishing, fish and wildlife habitat, swimming, and boating as well as provide visual contrast and aesthetic pleasure.

Public Access Board

The Public Access Board, under the Massachusetts Department of Fisheries, Wildlife and Recreational Vehicles, uses an appropriation from the General Fund to acquire public access to great ponds and other waters in the state and for trails for snowmobiling, hiking, and skiing. At its water access points, the board constructs launching ramps, canoe or small boat landings, parking areas, and approach roads.

The Public Access Board will continue to develop facilities throughout the state. The board's program concentrates on larger, more popular areas so that a larger number of people will benefit.

The Public Access Board has acquired access to the following waters in the Connecticut River Region of Massachusetts:

Water Body	Location	Area (acres)
Chicopee Study Area		
Asnacomet Pond	Hubbardston	127
East Branch, Ware River	Rutland	river
Hardwick Pond	Hardwick	99
Sugden Reservoir	Spencer	83
Westfield Study Area		
Congamond Lakes	Southwick	465
Highland Lake	Goshen	88
Windsor Pond	Windsor	79
Farmington Study Area		
Otis Reservoir	Otis	693
Shaw Pond	Otis	100
Upper Spectacle Pond	Sandisfield	60
Deerfield Study Area		
Deerfield River	Charlemont	river
Central Connecticut Valley Study Area		
Connecticut River	Hatfield	river
Oxbow, Connecticut River	Easthampton	oxbow and river

Water Body	Location	Area (acres)
Southern Connecticut Valley Study Area		
Connecticut River (east bank)	Chicopee	river
Connecticut (Bondi's Island)	West Springfield	river
Northern Connecticut Valley Study Area		
Barton's Cove, Connecticut River	Gill	river

Access to freshwater bodies in the region is usually a function of their ownership and use. Those reservoirs used for municipal water supply normally have restrictions upon public access and use. Swimming or wading is prohibited by state statute in all except supplementary, emergency supplies. Fishing and boating is also restricted, although there are instances of tightly-controlled reservoir fishing. An example is Quabbin Reservoir, a MDC water supply reservoir, which is one of the state's most outstanding fishery resources. Public access to the ponds, lakes, and reservoirs of the region is detailed in Appendix C prepared for this study by the Massachusetts Division of Water Resources.

The only federal lands in the region which offer recreation to the public are the seven Corps of Engineers' flood control or multiple-purpose reservoirs. These Corps of Engineers' waters and land amount to slightly over 11,000 acres and provide opportunities for swimming, fishing, picnicking, camping, hiking, and other activities. Approximately 7,400 acres in three of these projects are managed by Massachusetts Fisheries and Wildlife as wildlife habitat under an agreement with the Corps of Engineers.

The state government is the largest landholder of open space and recreation acreage in Massachusetts. The Division of Forests and Parks and the Division of Fisheries and Wildlife are the state agencies who administer most of the state's recreation acreage. Table 5.28 lists these areas, their location, and size.

Town conservation land, town forests, and sometimes water supply watershed lands provide passive recreation close to population centers.

Private lands which are open to the public for passive enjoyment are also important in the region. The Massachusetts Audubon Society controls approximately 1,800 acres of land which is managed for wildlife habitat and also provides hiking trails and opportunities to observe and enjoy the natural beauty of the areas. Also, the Trustees of Reservations are

TABLE 5.28 MAJOR PUBLIC AND QUASI-PUBLIC AREAS WITH RECREATION USE

Agency	Site 1/	Location	Size Acres
<u>Federal</u>			
U.S. Army Corps of Engineers	1. Birch Hill Dam 2/	Winchendon, Royalston, Templeton	4,478
	2. Tully Lake	Royalston, Orange, Athol	1,300
	3. Barre Falls Dam 2/	Barre, Hubbardston, Rutland, Oakham	577
	4. Conant Brook Dam	Monson	469
	5. Knightville Dam 2/	Huntington, Chesterfield	2,430
	6. Littleville Lake	Huntington, Chester	1,612
	7. Colebrook Lake (Mass. portion only)	Tolland, Sandisfield	325
	Subtotal - Federal		11,191
<u>State</u>			
Mass. Division of Forests and Parks	1. Morre Memorial S.P.	Paxton	310
	2. Charles M. Gardner S.P.	Huntington	29
	3. Chesterfield Gorge S.P.	Chesterfield	844
	4. Chicopee Memorial S.P.	Chicopee	574
	5. John C. Robinson S.P.	Agawam	858
	6. Joseph A. Skinner S.P.	Hadley, South Hadley	373
	7. Hampton Ponds S.P.	Westfield	9
	8. Mt. Sugarloaf S.R.	Deerfield	537
	9. Wilcox Hollow S.R.	Shelburne	25
	10. Deer Hill S.R.	Cummington, Plainfield	258
	11. Red Bridge S.P.	Ludlow, Palmer, Belchertown, Wilbraham	475
	12. Ashburnham S.F.	Ashburnham	1,637
	13. Hubbardston S.F.	Hubbardston, Phillipston	498
	14. Mass. Federation of Women's Club S.F.	New Salem, Petersham	1,083
	15. North Brookfield S.F.	North Brookfield	40
	16. Oakham S.F.	Oakham	861
	17. Royalston S.F.	Royalston	607
	18. Rutland S.F.	Rutland	1,900
	19. Petersham S.F.	Athol, Petersham	593
	20. Spencer S.F.	Spencer	1,408
	21. Templeton S.F.	Hubbardston, Templeton	1,495
	22. West Brookfield S.F.	West Brookfield	129
	23. Winchendon S.F.	Winchendon	178
	24. Buckland S.F.	Buckland	145
	25. Catamount S.F.	Colrain, Charlemont	1,111
	26. Chester-Blandford S.F.	Blandford-Chester	2,298
	27. Conway S.F.	Conway, Williamsburg	2,006
	28. Daughters of the American Revolution S.F.	Ashfield, Goshen	1,517

TABLE 5.28-cont. MAJOR PUBLIC AND QUASI-PUBLIC AREAS WITH RECREATION USE

Agency	Site 1/	Location	Size Acres
State			
Mass. Division of Forests and Parks cont.	29. Erving S.F.	Erving, Orange Warwick	3,040
	30. Hawley S.F.	Hawley, Plainfield, Windsor	7,676
	31. H.O. Cook S.F.	Colrain, Heath	1,620
	32. South River S.F.	Conway, Deerfield	500
	33. Huntington S.F.	Huntington, Montgomery	482
	34. Otter River S.F.	Royalston, Templeton Winchendon	883
	35. Leyden S.F.	Leyden	61
	36. Ludlow S.F.	Ludlow	50
	37. Montague S.F.	Montague	25
	38. Mt. Grace S.F.	Warwick	1,441
	39. Northfield S.F.	Northfield	237
	40. Orange S.F.	Orange	59
	41. Rowe S.F.	Rowe	267
	42. Warwick S.F.	Northfield, Orange, Royalston, Warwick	8,462
	43. Wendell S.F.	Montague, New Salem, Orange, Wendell	7,857
	44. Worthington S.F.	Worthington	175
	45. Mohawk Trail S.F.	Charlemont, Florida, Savoy, Hawley	6,451
	46. Middlefield S.F.	Middlefield	1,279
	47. Granville S.F.	Granville, Tolland	2,248
	48. Tolland S.F.	Blandford, Tolland	3,157
	49. Florida-North Adams S.F.	Florida, North Adams	510
	50. Monroe S.F.	Monroe, Florida	4,057
	51. Otis S.F.	Becket, Otis, Sandisfield, Tyringham	4,391
	52. Peru S.F.	Peru, Middlefield, Worthington	2,860
	53. Cookson S.F.	Sandisfield, New Marlborough	2,378
	54. Sandisfield S.F.	Sandisfield	4,173
	55. West Lake Recreation Area	Sandisfield	1,340
	56. Savoy S.F.	Savoy, Adams, Florida, North Adams	10,846
	57. Windsor, S.F.	Savoy, Windsor	1,791
	Subtotal - Division of Forests and Parks		100,114

TABLE 5.28-cont. MAJOR PUBLIC AND QUASI-PUBLIC AREAS WITH RECREATION USE

Agency	Site 1/	Location	Size Acres
Mass. Division of Fisheries and Wildlife	1. Birch Hill W.M.A.	Winchendon, Templeton	1,376
	2. Phillipston W.M.A.	Barre, Phillipston, Petersham	1,866
	3. Quaboag W.M.A.	Brookfield, West Brookfield, Warren, Sturbridge	890
	4. Moose Hill W.M.A.	Paxton, Leicester, Spencer	667
	5. Winimusset W.M.A.	New Braintree	416
	6. Millers River W.M.A.	Athol, Royalston, Phillipston, Winchendon	1,553
	7. Four Chimneys W.M.A.	Spencer	220
	8. Watatic Mountain W.S.	Ashburnham, Ashby	139
	9. Hubbardston W.M.A. 3/	Hubbardston	2,000
	10. East Branch Ware River Access Area	Rutland	80
	11. Poland Brook W.M.A.	Conway, Ashfield	525
	12. Pauchaug Brook W.M.A.	Northfield	161
	13. Bitzer Fish Hatchery	Montague	72
	14. Sunderland Fish Hatchery	Sunderland	103
	15. Canada Hill W.M.A.	Chesterfield, Chester, Huntington, Worthington	1,949
	16. Westfield River W.M.A.	Cummington	80
	17. Swift River W.M.A.	Belchertown, Ware	1,409
	18. Shepard's Island W.M.A.	Northampton	15
	19. Little River Access Area	Huntington, Worthington	182
	20. Wilbraham Game Farm	Wilbraham	144
	21. Palmer Experimental Hatchery	Palmer	302
	22. John J. Kelley Memorial Forest & W.M.A.	Chester	267
	23. Grace Robinson W.S.	Montgomery, Westfield	70
	24. Peru W.M.A.	Peru	2,525
	25. Becket W.M.A.	Becket	234
	26. Savoy W.M.A.	Savoy	420
	27. Chalet W.M.A.	Windsor, Dalton	515
	Subtotal Division of Fisheries and Wildlife		18,180
Metropolitan District Commission	1. Quabbin Reservoir Reservation 4/	New Salem, Shutesbury, Belchertown, Pelham, Ware, Hardwick, Petersham	80,420
	2. Ware River Reservation 3/	Barre, Hubbardston, Oakham, Rutland	20,250
	Subtotal Metropolitan District Commission		100,670

TABLE 5.28 - cont. MAJOR PUBLIC AND QUASI-PUBLIC AREAS WITH RECREATION USE

Agency	Site 1/	Location	Size Acres
Mass. Water Resources Commission	1. Sucker Flood Control Project	West Brookfield	83
	2. Lamberton Flood Control Project	Warren, West Brookfield	15
	3. Horsepond Flood Control Project	North Brookfield	176
	4. Kittredge Flood Control Project	North Brookfield, Spencer	135
	5. North Silver Lake Flood Control Project	Sandisfield	191
	6. South Silver Flood Control Project	Sandisfield	114
	7. Clam Lake Flood Control Project	Sandisfield	515
	Subtotal Massachusetts Water Resources Commission		1,229
University of Massachusetts	1. Mt. Toby S.F.	Sunderland, Leverett	726
	2. Cadwell Memorial Forest	Pelham	1,195
Hampshire and Hampden Counties	1. Mt. Tom S.R.	Holyoke, Easthampton	1,800
Franklin County	1. Herlihy Memorial Park	Whately	15
	Subtotal State and County		223,929
Trustees of Reservations	1. Elliot Laurel Reservation	Phillipston	33
	2. Royalston Falls	Royalston	205
	3. James W. Brooks Woodland Preserve	Petersham	388
	4. Doane's Falls	Royalston	30
	5. Jacob Hill	Royalston	53
	6. Chapelbrook Reservation	Ashfield	128
	7. The Bear's Den	New Salem	4
	8. Bear Swamp Reservation	Ashfield	171
	9. Dinosaur Footprints	Holyoke	8
	10. William Cullen Bryant Homestead	Cummington	189
	11. Glendale Falls	Middlefield	60
	12. Chesterfield Gorge	Chesterfield	161
	13. Petticoat Hill	Williamsburg	60
	14. Notchview Reservation	Windsor	3,000
	Subtotal Trustees of Reservations		4,490

TABLE 5.28 - cont. MAJOR PUBLIC AND QUASI-PUBLIC AREAS WITH RECREATION USE

Agency	Site 1/	Location	Size Acres
Massachusetts Audubon Society	1. Burncoat Pond W.S.	Leicester, Spencer	175
	2. Cooks Canyon W.S.	Barre	40
	3. Rutland Brook W.S.	Petersham	320
	4. Arcadia W.S.	Easthampton, Northampton	560
	5. Laughing Brook Educational Center & E. J. Weff Bird Sanctuary	Hampden	259
	6. The Ledges	Shelburne	413
	Subtotal Massachusetts Audubon Society		1,767
Norcross Wildlife Foundation	1. Norcross Wildlife	Monson, Hampden	3,000
REGION TOTAL - Public & Quasi-Public			244,377

1/ Following abbreviations are used: S.F.--State Forest; S.P.--State Park; S.R.--State Reservation; W.S.--Wildlife Sanctuary; W.M.A.-- Wildlife Management Area.

2/ Managed by Division of Fisheries and Wildlife by Agreement.

3/ Managed by Division of Fisheries and Wildlife by agreement with MDC.

4/ Public access is restricted from a large portion of Quabbin Reservoir's lands and water.

SCS PHOTO

The Westfield River flows through Chesterfield Gorge, a Trustees of Reservation property.

responsible for the management of approximately 4,400 acres of natural areas which are used extensively for passive recreation. Another important private institutional holding is the 3,000-acre Norcross Wildlife Santuary in Hampden and Monson.

The electric power companies of the region provide many recreational opportunities for the public. The Bear Swamp and the Northfield Mountain pumped storage projects supply picnic sites, public boat launch and fishing access areas, hiking trails, and other day use facilities. The visitor centers at both these facilities provide the general public with information and interesting educational programs and exhibits.

The only major state recreation project identified by the 1976 SCORP report for the region is the Holyoke Range acquisition project. This project is on a par with the other eight major state projects such as the Boston Harbor Islands project. This project will involve the acquisition of approximately 3,000 acres on the Mt. Holyoke Range. This undeveloped east-west trending ridge separates the urbanized Springfield-Holyoke-Chicopee area to the south from the more agricultural and lower populated areas of Franklin and Hampshire Counties to the north. The range rises 600 to 800 feet above the Connecticut River Valley floor and preservation of this ridge will maintain this most attractive visual asset in its present forested condition. Acquisition of lands for this project is now underway and, as of January 1978, approximately 1,000 acres have been acquired by the Massachusetts Division of Forests and Parks.

The Connecticut River Basin Study recommended the establishment of a Connecticut River National Recreation Area of which the Holyoke Range would be one of the major units. The national recreation area proposal has not been approved and funded by Congress. The state project is a scaled-down version of the federal proposal, but still includes the major feature of the federal proposal--preservation of the ridge line.

In 1972, the New England River Basins Commission published the <u>1980 Connecticut River Basin Plan</u>. The recreation orientated recommendations include:

"2. <u>Land Acquisition/Controls</u>

a. <u>Nonstructural Flood Plain Management Recommendation</u>:

Preservation and controlled use of the undeveloped or sparsely settled flood plains, with particular inference to flood plains now in agricultural, recreational, or other open space uses:

SCS PHOTO

Swimming at a municipal beach in Whately.

SCS PHOTO

The Mount Holyoke Range viewed from the north in Hadley.
Acquisition of this range is the major Department of
Environmental Management project in the region.

c. Streambank Acquisition Recommendation:

Streambank acquisition

Objective:

To provide public access to fisheries resources; (coordinated with other measures) to protect the flood plains from further encroachment and to preserve reaches of river identified as wild scenic or recreational."

Other recreational recommendations from this Basin Plan, such as the Wild Scenic and Recreational Rivers program, the Connecticut River National Recreation Area proposal have been discussed above.

There are numerous opportunities for hiking in the region. The Metacomet-Monadnock Trail which originates in Connecticut, runs along the Mt. Tom Range and the Holyoke Range on its way to Mt. Monadnock in New Hampshire. The Massachusetts portion of this trail is approximately 98 miles long. The Massachusetts Division of Forests and Parks is currently establishing two east to west trails which will ultimately link the Metacomet-Monadnock Trail to the Appalachian Trail in Berkshire County. These trails are the Deerfield River Trail in Franklin County and the Westfield River Trail in Hampshire County. There are also many shorter trails in the state forests and parks, the MDC Quabbin Reservation, and on municipal and private lands.

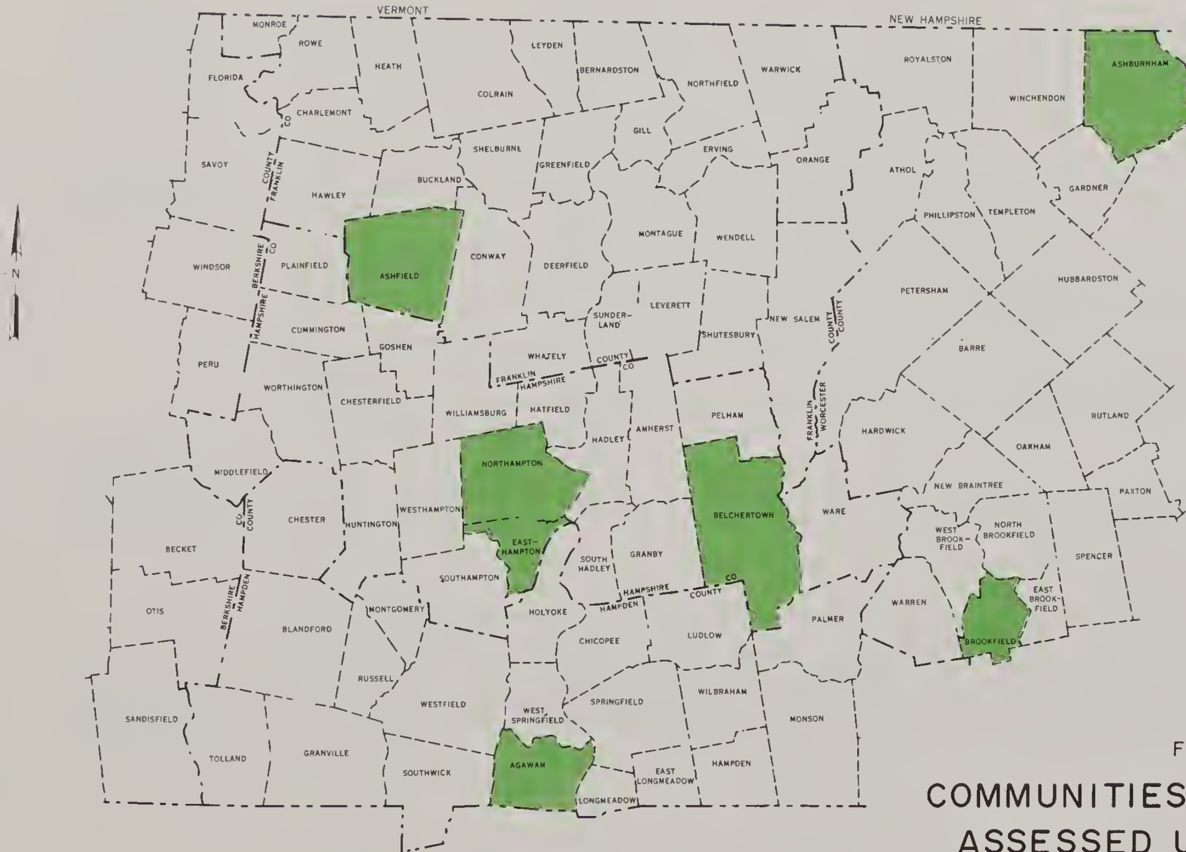
5.12 EXISTING PROGRAMS

Information on programs which affect the resources addressed in this study is summarized in the following tables and figures.

TABLE 5.29

EXISTING PROGRAMS

Subject	Agency	Law or Program
Land Use	Municipalities	Massachusetts General Laws, Chapter 61A, Sections 1-24 - The Agricultural and Horticultural Assessment Act. The act is designed to provide economic incentives in the form of lower property taxes to encourage maintenance of productive agricultural or horticultural pursuits. The act also has the effect of preserving open space. Massachusetts is one of 32 states that provide for such assessments. This act is sometimes referred to as the "Current Use Taxation of Farmland and Horticultural Land."
	Municipalities	Massachusetts General Laws, Chapter 184, Sections 23-33 - An act to protect conservation and preservation restrictions which are held by an appropriate public authority.
	Municipalities, Mass. Division of Forests and Parks	Massachusetts General Laws, Chapter 61, Sections 1-7 - The Classification and Taxation of Forest Lands (General Laws, Chapter 61) as amended. Landowners who have at least 10 contiguous acres of forest land having a value not over $400 an acre (land and timber) may apply to their local tax assessors to have their forest land classified under the law. If the state forester determines that the woodland owner qualifies, the land and timber are taxed separately. The land is assessed at not more than $10 per acre and annual taxes are paid on this basis. Also, a forest products tax of 8 percent is paid on the value of forest products harvested. A rollback applies if the land is withdrawn from the forest classification. In addition to the tax incentive program for private landowners there is a forest management program for public forest holdings.
	Soil Conservation Service, Conservation District, landowners	Conservation Operations Program - Proper land treatment is the basic concern of the Soil Conservation Service. This is the purpose of the Conservation Operations Program which provides technical assistance and advice on soil and water conservation to land users through local conservation districts. In the region, requests for assistance go to the Berkshire, Franklin, Hampshire, Northwestern Worcester, Southern Worcester or Hampden Conservation Districts which determines priorities for the Conservation Operations Program. The district is an arm of state government, having five unpaid supervisors whose job it is to develop overall conservation programs to solve problems in their area. They may carry out projects on their own and enlist the cooperation of state and federal agencies. Practices applied in the Conservation Operations Program include improved agronomic practices, measures to reduce soil erosion, practices designed to help carry water safely off sloping land, drainage improvements, and comprehensive measures to improve wildlife habitat and recreational areas.
	Farmers Home Administration, landowners	Soil and Water Loans - These loans are to facilitate improvement, protection, and proper use of farmland by providing adequate financing and supervisory assistance for soil conservation; water development, conservation and use; forestation; drainage of farmland; the establishment and improvement of permanent pasture; and related measure. Loans cannot exceed $100,000.
	U.S. Agricultural Stabilization and Conservation Service, landowners	The Agricultural Conservation Program (ACP), provides cost sharing assistance to farmers and other landowners who undertake soil, water, forest and wildlife conservation practices. The cost for such practices is shared between the federal government and the landowner. Technical assistance for ACP practices is rendered by the Soil Conservation Service, the Extension Service, and the U.S. Forest Service in cooperation with the Massachusetts Division of Forests and Parks.



LEGEND

COMMUNITIES WITH CH.61A ASSESSMENTS AS OF JUNE 1977

FIGURE 5.16

COMMUNITIES WITH SOME LAND ASSESSED UNDER G.L. CH.61A, THE AGRICULTURAL AND HORTICULTURAL REASSESSMENT ACT

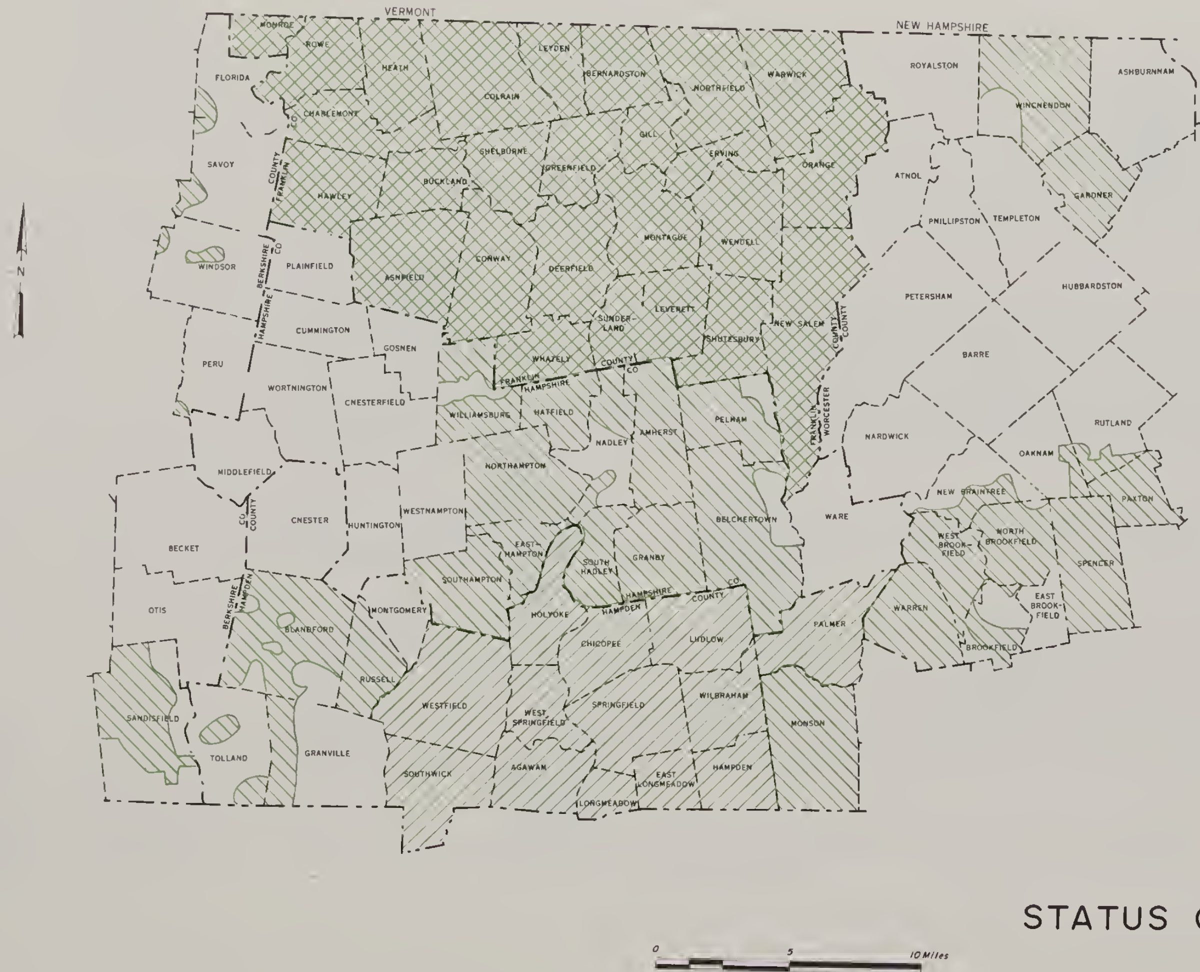
CONNECTICUT RIVER REGION

MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TABLE 5. 29 - cont. EXISTING PROGRAMS

Subject	Agency	Law or Program
Land Use cont.	Municipalities	Zoning Enabling Act, Mass. General Laws Chapter 40A - The Act contains the basic authority for municipal zoning, predicated on the traditional police power concept of the promotion of health, safety, morals and general welfare. The Act authorizes municipalities to enact zoning laws designed among other purposes to lessen congestion in the streets, to conserve health; to secure safety from fire, panic and other dangers; provide adequate light and air; to prevent overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks and other public requirements; to conserve the value of land and buildings; to encourage the most appropriate use of land throughout the city or town; and to preserve and increase its amenities. Zoning may regulate and restrict the height, number of stories, and size of buildings and structures, the size of width of lots, the percentage of lot that may be occupied, the size of yards, courts and other open spaces, the density of population, and the location and use of buildings, structures and land for trade, industry, agriculture, residence or other purposes.
	Municipalities	Earth Removal-Mass. General Laws Chapter 40, Section 21 (17) and Chapter 40A, Section 2 - Municipal regulation of the extraction of removal of soil, sand, gravel, and other minerals was first carried on under the Zoning Enabling Act, which specifically authorizes municipalities to "regulate and restrict the...use of land...and (to) prohibit noxious trades within the municipality or any specified part thereof." The state legislature further empowered municipalities to enact nonzoning bylaws "prohibiting or regulating the removel of soil, loam, sand or gravel from land." In addition to exempting public land, the nonzoning bylaw must exempt earth removal which is part of site preparation for an approved subdivision or which is "the subject of a permit or license issued under the authority of the town." Because of these limitations, communities may and often do use both types of bylaws to ensure adequate coverage. Typically, such bylaws require a permit for earth removal and impose certain conditions upon the operation as a prerequisite to obtaining such a permit. Conditions may include, for example, control of drainage, maintenance of buffer zones along wetlands or public ways, screening and fencing, measures to reduce dust, limitation of the hours of operation; and grading, reloaming and reseeding after the work is done.
	Municipalities	Agricultural Preservation - Chapter 232 of the Acts of 1977 authorizes cities and towns to appropriate money for the purchase of development rights on farmlands.
	Municipalities & Mass. Dept. of Agriculture	Agricultural Preservation - Chapter 780 of the Acts of 1977 provides for the acquisition of agriculture preservation restrictions by the Commonwealth.



LEGEND

- AREAS PUBLISHED
- AREAS COMPLETE-PUBLICATION PENDING
- SOIL MAPPING COMPLETED

FIGURE 5.17

STATUS OF SOIL SURVEYS

CONNECTICUT RIVER REGION
MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TABLE 5.29 - cont. EXISTING PROGRAMS

Subject	Agency	Law or Program
Land Use cont.	U.S. Soil Conservation Service, municipalities	Soil Survey - The SCS has the federal leadership for conducting the National Cooperative Soil Survey. In Massachusetts, the soil survey is carried on cooperatively with the Massachusetts Agricultural Experiment Station. Soil survey activities include the mapping, classification, correlation, and interpretation of soils according to national standards. The surveys are a basic scientific inventory of soil resources, based on soil properties. These surveys identify the kinds of soils, their extent, location and characteristics. Soil surveys play a vital part in planning by: 1. Providing a permanent inventory of the soil resources. 2. Providing soil interpretations for various uses to guide planners at the local, regional, and state levels in making sound land use decisions for developing comprehensive plans. 3. Providing data on the location of: a. wetlands, steep land, rocky land and areas with a high water table; b. areas suitable for waste disposal; c. areas that are suitable for use as residential, commercial, industrial, or school sites. 4. Providing many other soil interpretations that contribute to planning for a better quality environment. Many communities need, and want, soil survey information before the report is published in the usual manner. To provide this information ahead of the published report time, the SCS in Massachusetts prepares special soils reports for those communities which help pay for cost of preparation. A town soils report consists of a narrative description of each soil found within the community, copies of the soil survey mapping sheets and interpretative maps. These interpretative maps show the limitations of the soils for selected uses, such as sewage disposal, home sites or industrial sites. See Figure 5.17 for the status of the soil survey in the region.
	U.S. Soil Conservation Service, other USDA agencies, municipalities Conservation Districts	Resource Conservation and Development Areas - Resource Conservation and Development (RC&D) Areas are locally initiated, sponsored and directed programs which are planned to accelerate the conservation and development of natural resources; improve the general level of economic activity; and enhance the environment and standards of living. Each RC&D plan has its own unique goals. RC&D areas are sponsored by Conservation Districts, towns and county governments, and may include municipalities, state agencies, comprehensive planning agencies and local nonprofit organizations. In Massachusetts two RC&D areas have been established: The Berkshire-Franklin RC&D Area in Berkshire and Franklin Counties and the Pilgrim RC&D Area in Barnstable, Bristol, Dukes, Nantucket, and Plymouth Counties.

TABLE 5.29 - cont.

EXISTING PROGRAMS

Subject	Agency	Law or Program
Land Use cont.	U.S. Soil Conservation Service, other USDA agencies, municipalities, Conservation Districts cont.	The Berkshire-Franklin RC&D Area Plan Supplement No 2, October 1977, states that the overall goals are: "to improve environmental quality through optimum use of natural resources, provide a favorable climate for expanding industry, commerce and community services, and publicize the area as an attractive place to live, work, and play." Objectives to meet these goals are: 1. Provide needed resource data to decision makers by 1990 to enable wise land use decisions. 2. Eliminate isolated flood damage areas by installing five flood prevention and/or land drainage measures by 1990. 3. Increase the conservation education opportunities in the RC&D area. 4. Assist in the development or acceleration of two human health programs by 1981. 5. Assist in the development and implementation of pollution control programs by 1990. 6. Assist area legislators with the identification of, and encourage support for, legislation contributing toward RC&D area goals. 7. Encourage new and expanding industry which will increase employment opportunities and the tax base by 1990. 8. Assist with the installation of fish, wildlife, and recreation measures to meet recreational demands of residents and tourists by 1989.
	U.S. Soil Conservation Service, Extension Service, Mass. Division of Forests and Parks, Mass. Division of Fisheries and Wildlife, Conservation Districts, municipalities	Natural Resources Planning Program - The NRPP provides for local communities to inventory their present natural resources, to rate those resources against standards and criteria, to determine the consequences of proposed actions on natural resource base, and to plan the most acceptable future course of action to maintain or improve the community's level of environmental quality. The Natural Resources Planning Program: 1. Gives citizens the major role, with local people doing most of the work, making all the decisions, and implementing any needed changes in community policies to meet their goals, 2. closely relates the community's natural resources base to numbers of people the natural resources can safely support, 3. provides help from regional technical teams that represent many agencies and disciplines. The teams are composed of personnel from the Soil Conservation Service, Cooperative Extension Service, Massachusetts Division of Fisheries and Wildlife, and Massachusetts Division of Forests and Parks. Other state and federal agencies assist as requested. The Conservation District accepts applications from communities requesting the program, screens the applications, establishes priorities for assistance by the technical teams, and coordinates agency assistance to the selected communities,

TABLE 5.29 - cont.

EXISTING PROGRAMS

Subject	Agency	Law or Program
Land Use cont.	U.S. Soil Conservation Service, Extension Service, Mass. Division of Forests and Parks, Mass. Division of Fisheries and Wildlife, Conservation Districts, municipalities - cont.	4. includes standards and criteria for rating the resource base, 5. is "open ended": Local citizens can continually monitor their area's natural resource condition and update land use plans as needed. One of the most important aspects of the program is its emphasis on citizen involvement . Local citizens provide the personnel to: (1) inventory, in detail, the present natural resources of their community, (2) rate these natural resources against existing standards and criteria, (3) identify problem areas, (4) assess alternative courses to action, (5) prepare a definite plan of action and then, (6) implement planned measures to maintain or enhance their natural resources to achieve the community's selected level of environmental quality. Whatever consequences of those actions on the natural resource base. Over 20 communities in Massachusetts have started work under this program; however, in the region only two towns, Granby and Spencer have enrolled in this program.
	Farmers Home Administration, RC&D sponsors	Resource Conservation and Development Loans - These loans are to assist sponsoring public agencies in Resource Conservation and Development (RC&D) Areas. Loan funds may be used for (1) rural community public outdoor-oriented water-based recreational facilities; (2) soil and water, development, conservation control and use facilities; (3) community water storage facilities. Loans cannot exceed $250,000.
	U.S. Soil Conservation Service Extension Service, Mass. Natural Resources agencies	Natural Resource Inventories - These studies identify and describe areas with natural resource development potential within the community. Each area is described and its alternative development potentials are listed in a report. Opportunities and problems in the use of each site or areas are identified and discussed. The Soil Conservation Service, County Regional Extension Service, Massachusetts Division of Forests and Parks, Massachusetts Division of Fisheries and Wildlife and other agencies conduct natural resource inventories for communities. A community wishing a natural resource inventory requests help from the Conservation District which, in turn, a arranges for the inventory.
Land Use Forest land	U.S. Forest Service, Mass. Division of Forests and Parks, landowners	Renewable Resources Program - The Forest Resources Planning Act of 1974 provides for long-term planning for the management, protection and utilization of all renewable resources on forest land. The Forest Service and the Massachusetts Department of Environmental Management, Division of Forests and Parks, cooperatively conduct forestry programs on state and privately owned forest land. The forest resources of the Connecticut River Region also benefit from research in various aspects of forestry conducted at 80 different laboratories and other scientific facilities. These activities are grouped into five systems: recreation, wildlife, timberland and water, human and community development.

TABLE 5.29 - cont.

EXISTING PROGRAMS

Subject	Agency	Law or Program
Land Use Forest land cont.	U.S. Forest Service, Mass. Division of Forests and Parks, Landowners - cont.	Recreation System - The goal of this system is to increase the supply of outdoor recreation opportunities and services through programs which emphasize dispersed recreation. Assistance is given private forest landowners who are interested in helping provide public recreation opportunities, or integrate multiple uses into their forest management programs.
		Research is conducted to strengthen technology and understanding of recreation demands, trends, values and environmental impacts, as well as quantify and rank commodity and amenity values.
		Wildlife System - This system provides for increased use and enjoyment of wildlife while increasing both the diversity and numbers of fauna and the protection of threatened and endangered species. Technical assistance and financial incentives encourage nonindustrial private forest landowners to include habitat protection and development among their own management objectives.
		Research emphasizes habitat identification and improvement for endangered species and the impact of alternative forest practices on game and nongame habitats and populations.
		Timber System - The goal for the timber system is to increase timber supplies and quality to the point where benefits are commensurate with costs. Opportunities to increase timber supply exist on small private holdings, as well as, on Massachusetts state-owned forest areas. The program provides incentives for private timber landowners to grow commercial timber and for improved use of the trees and logs that are harvested.
		Major research includes better utilization of timber; improving the rates of timber growth and yield, improving the protection for forests from wild fire, insects and diseases; and proving better inventory and evaluation of resources.
		Land and Water System - The land and water system is an aggregation of many basic stewardship and land treatment activities to meet minimum air and water quality standards. This system permits control of man-caused erosion on state and private forest lands through technical assistance and program support.
		Important areas of research include the nature and extent of nonpoint sources of pollution, improved logging practices for fragile soils and steep slopes, and improved efficiency of fire prevention and firefighting operations.
		Human and Community Development System - This system is concerned with the relationships between man and his forest environment. All renewable resource programs are focused to increase goods and services from forest land; this means serving employment, housing and other social needs.
		Assistance to communities is provided for urban and community forestry, rural community fire protection and land use planning. Conservation education and manpower training programs are designed to enhance the knowledge and skills of rural residents.

TABLE 5.29 - cont.

EXISTING PROGRAMS

Subject	Agency	Law or Program
Land Use Forest land cont.	Mass. Natural Resource Agencies	The Massachusetts Department of Environmental Management and the Massachusetts Department of Fisheries, Wildlife and Recreational Vehicles are applying multiple-use management to approximately 115,000 acres of forest land under their jurisdiction as authorized under General Law 132, Section 31, and General Law 131, Section 6. Also, the Metropolitan District Commission is applying multiple-use management to approximately 78,000 acres of forest land in the Quabbin Reservoir and the Ware River Reservations.
	U.S. Agricultural Stabilization and Conservation Service, landowners	The Forest Incentives Program (FIP) provides cost-sharing assistance to landowners who undertake forestry conservation practices. Program objectives are to increase the production of timber and wood products to reduce and abate pollution of streams and other bodies of water by planting trees in disturbed areas and to benefit communities by providing wildlife and landscape beauty and increasing outdoor recreation opportunities. The cost for such practices is shared between the federal government and the landowner. Technical assistance is provided by the SCS and the Forest Service in cooperation with the Massachusetts Division of Forests and Parks.
Flooding	U.S. Soil Conservation Service, state and local governments	Public Law 83-566, The Small Watershed Protection and Flood Prevention Program - PL-566 provides federal technical, and financial assistance to states, local communities, conservation districts, and other groups in solving their land and water problems. Project purposes which may be included in a PL-566 watershed plan include: conservation land treatment, flood prevention, agricultural water management, industrial and municipal water supply, recreation and fish and wildlife. Flood prevention must be a major concern in each project. PL-566 watersheds are limited to 250,000 acres in size. The program applies to land and water resource problems which cannot be solved by individual landowners on their own property. The PL-566 watershed program helps improve the quality of the natural resource base, the quality of the environment and the quality of the standard of living by: 1. Reducing erosion and sedimentation through the application of land treatment practices. 2. Identifying flood hazard areas for flood plain management measures. 3. Promoting proper land use and management. 4. Improving agricultural water management practices. 5. Providing multiple-purpose reservoirs for recreation, fish and wildlife, and water supply. 6. Reducing flood damages, hazards to life and health, and the inconvenience caused by flooding. In the Connecticut River Region eight watersheds are, or have been, involved in the PL-566 program. See Figure 5.18 for the location of these watersheds.

TABLE 5.29 - cont.

EXISTING PROGRAMS

Subject	Agency	Law or Program
Flooding cont.	Farmers Home Administration, PL-566, local sponsors	Watershed Protection and Flood Prevention Loans - These loans provide assistance to local PL-566 sponsors to provide the local cost of improvements for flood prevention, irrigation, drainage, water quality management, sedimentation control, fish and wildlife development, public water-based recreation, and water storage and related costs. Applicants must have authority under state law to obtain, give security for and raise revenue to repay the loan and operate and maintain the facilities to be financed. The total amount of loans outstanding in any one watershed is limited to $5,000,000.
	U.S. Department of HUD and municipalities	National Flood Insurance Program - As of July 1977 all but 21 towns in the region had joined the National Flood Insurance Program, and property owners can now purchase low cost flood insurance protection. In return for this federally-subsidized insurance, the towns are required to consider flood hazards before issuing building permits, subdivision approvals, or zoning variances. After detailed hydrologic and hydraulic studies are made, HUD will issue flood zone maps which accurately delineate the flood hazard area and depth of flooding. Local governments must then require all new construction be above the 100-year flood elevation. Most financial institutions must require that flood insurance be purchased on any property within the flood hazard zone on which mortgages are accepted. As a condition of participation in the National Flood Insurance Program, a community must adopt flood plain management regulations meeting minimum standards published by the Federal Insurance Administration. A community must: (1) require building permits for all new construction and substantial improvements and (2) review the permit to assure that sites are reasonably free from flooding. For its flood prone areas the community must also require: (1) proper anchoring of structures, (2) the use of construction materials and methods that will minimize flood damage, (3) adequate drainage for new subdivisions, and (4) that new or replacement utility systems be located and designed to preclude flood loss.
	Mass. Department of Environmental Management, municipalities	Massachusetts General Laws, Chapter 232 and 780, Acts of 1977, the acquisition of Agricultural Preservation Restrictions is seen as a means of flood plain management by the Massachusetts Department of Food and Agriculture. Massachusetts General Laws, Chapter 131, Section 40A - The Inland Wetlands Restriction Act allows the Commissioner of Environmental Management, with the approval of the Board of Environmental Management, for the purpose of promoting the public safety, health and welfare, and protecting public and private property, wildlife, fisheries, water resources, flood plain areas and agriculture, can adopt, amend or repeal orders regulating, restricting, or prohibiting dredging filling, removing, or otherwise altering or polluting inland wetlands, or set encroachment lines on flood prone areas.
	Mass. Division of Conservation Services, municipalities, Heritage Conservation and Recreation Service	Federal and state cost sharing funds available to the cities and towns for use in purchasing conservation, open space and recreation areas can also serve as a means of flood plain management. The Division of Conservation Services administers the Massachusetts Self-Help Act (General Law, Chapter 40, Section 8C) and administers or coordinates the Land and Water Conservation Program (PL 88-578) of the Heritage Conservation and Recreation Service (U.S. Department of the Interior) within Massachusetts.

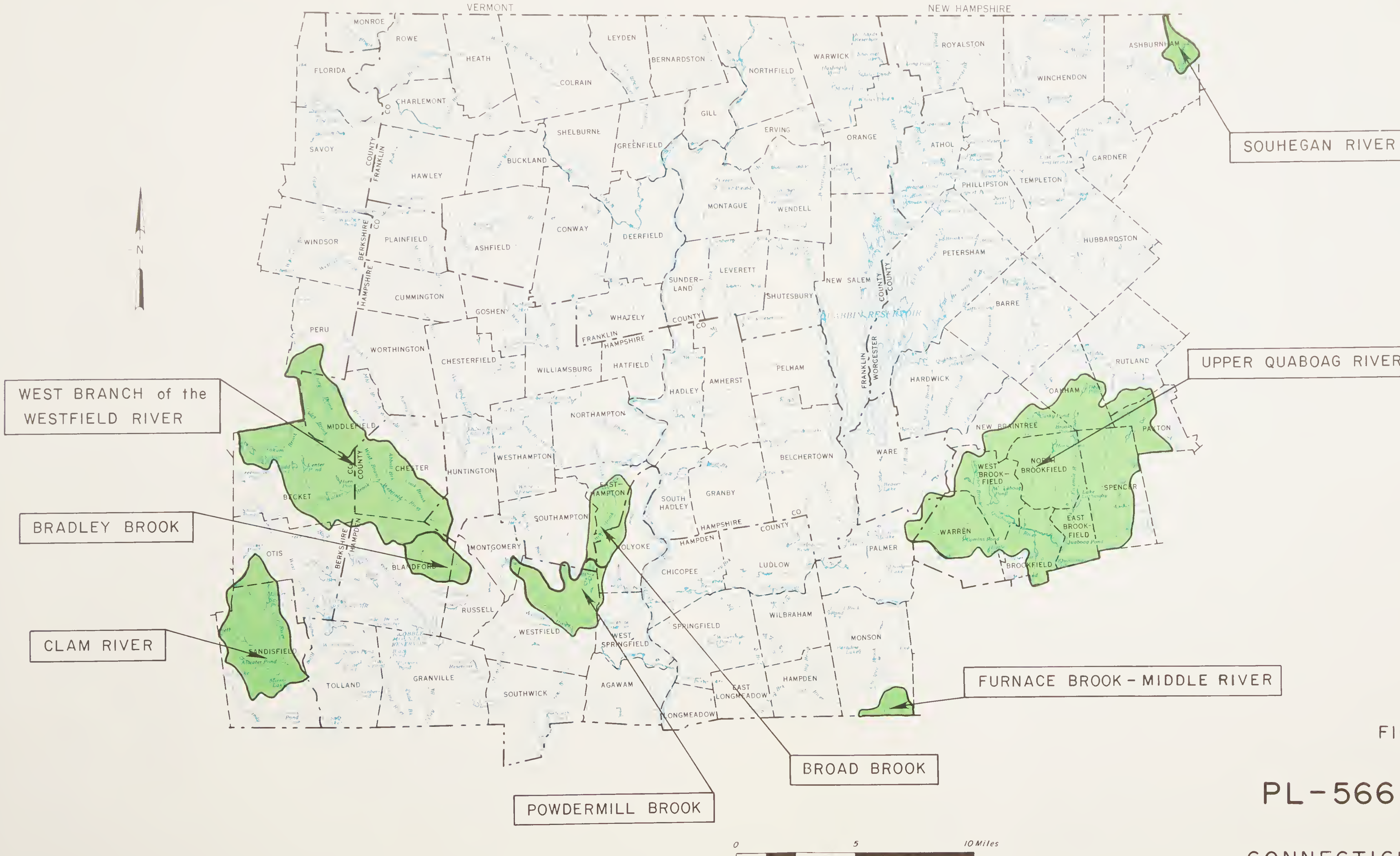
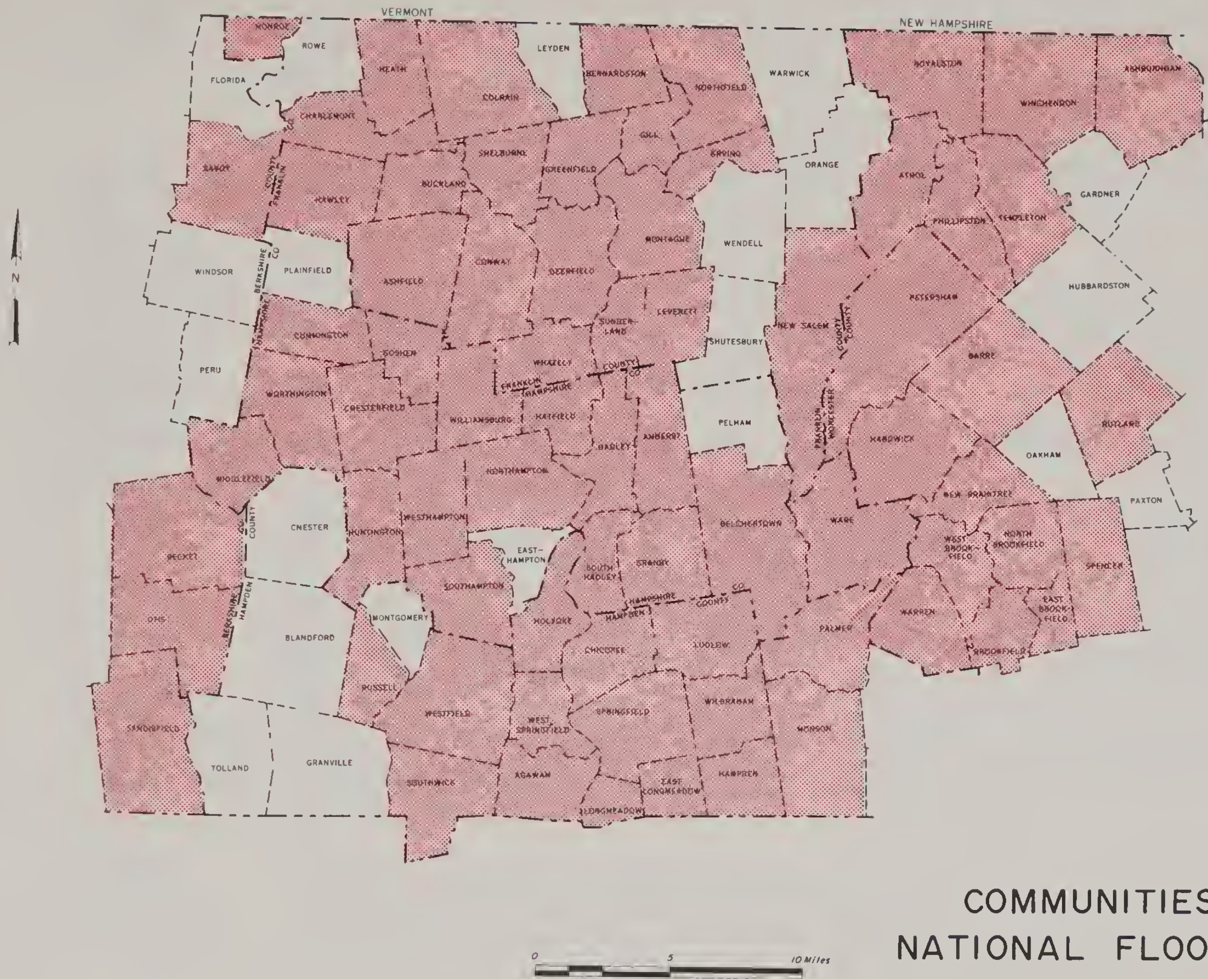


FIGURE 5.18

PL-566 WATERSHEDS

CONNECTICUT RIVER REGION
MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



LEGEND

PARTICIPATING COMMUNITY

FIGURE 5.19

COMMUNITIES PARTICIPATING IN NATIONAL FLOOD INSURANCE PROGRAM

CONNECTICUT RIVER REGION
MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TABLE 5.29 - cont.

EXISTING PROGRAMS

Subject	Agency	Law or Program
Erosion and Sediment	U.S. Soil Conservation Service, Conservation Districts, landowners	Conservation Operations Program - Landowners and communities are assisted in their efforts to control erosion and sediment and in other conservation efforts by the Conservation Districts. The districts coordinate assistance from the Soil Conservation Service, the Extension Service, the Massachusetts Division of Forests and Parks in cooperation with the U.S. Forest Service for forest lands, and from other state and federal agencies.
Wetlands	Mass. Department of Environmental Management, Department of Environmental Quality Engineering	Massachusetts General Laws, Chapter 131, Section 40 - The "Hatch Act" passed by the Massachusetts General Court in 1965, attempted to control the alteration of the wetlands. This act has been modified several times by the General Court. The comparable legislation in force today is Chapter 131, Section 40, of the General Laws as amended by Chapter 818 of the Acts of 1974 and Chapter 363 and 334 of the Acts of 1975. This act controls, but does not ban development on wetlands. The law requires that any person or governmental agency intending to remove, fill, dredge, or alter a wetland must insure, by following various procedural and technical steps, that the activity will have no adverse effect on water supplies, flood prevention, pollution prevention, or fisheries protection. In effect the act requires an owner desiring to develop his wetlands do so in accord with public interest and safety. Chapter 131, Section 40, now called the <u>Wetlands Protection Act</u> is administered by town or city conservation commissions or the city mayor or town selectmen in communities without conservation commissions. Appeals from local decisions go first to the Massachusetts Department of Environmental Quality Engineering and, if unresolved at that level the courts become the final arbitrators.
	Mass. Department of Environmental Management, municipalities	Massachusetts General Laws, Chapter 131, Section 40A - <u>The Inland Wetlands Restriction Act</u> (see above write-up under Subject - Flooding).
	Mass. Division of Fisheries and Wildlife, Mass. Division of Forests and Parks	Massachusetts state agencies, in particular, the Division of Forests and Parks and the Division of Fisheries and Wildlife have active land acquisition programs. In addition, the Division of Fisheries and Wildlife has given emphasis to wetlands acquisition to permanently protect wetlands having primary significance to fish and wildlife.
	Municipalities	Many communities in the region have embarked on conservation area plans which attempt to preserve and enhance the natural resources, and especially the water resources, within the community. Usually this effort is spearheaded by city or town conservation commissions which are authorized to prepare conservation and outdoor recreation plans, acquire open space, land and water areas, prepare and maintain open space areas, and advise local officials on matters relating to conservation subjects.

TABLE 5.29 - cont. EXISTING PROGRAMS

Subject	Agency	Law or Program
Wetlands cont.	U.S. Department of HUD, municipalities	In addition to acquisition programs, communities can adopt flood plain zoning ordinances to regulate the use of their wetlands and flood prone area. Restrictions imposed by the National Flood Insurance Program also tend to restrict wetland flood plain development. See the Flooding Section for more details on the National Flood Insurance Program.
	Interested Groups	The Massachusetts Audubon Society, Trustees of Reservations and other similar organizations assist individuals and municipalities in protecting the region's wetlands and other natural resources. These groups engage in various activities including environmental education; acquisition of wetlands, flood plain and other important natural resource areas; wildlife sanctuary and reservation management; and assistance to the region's cities and towns in their respective wetland and other resource programs.
Water Quality	Environmental Protection Agency, Mass. Division of Pollution Control, Mass. Division of Environmental Health, municipalities, industries	Restoration and maintenance of water quality has been the result of a combined effort by the federal, state, and local governments; and private industry. The primary federal agency concerned with water quality is the Environmental Protection Agency. The Massachusetts Department of Environmental Quality Engineering is the lead state agency. Important divisions include the Division of Water Pollution Control and the Division of Environmental Health.
Water Supply	U.S. Dept. of Commerce municipalities	Grants and Loans for Public Works and Development Facilities - This program provides grants of up to 50 percent of the development cost for such public facilities as water and sewer systems, and flood control projects. Jurisdictions designated as redevelopment areas may qualify for grants and loans. These areas may be counties, labor areas, or larger cities characterized by high unemployment or low family income. Severely depressed areas that cannot match federal funds may receive supplementary grants to bring the federal contribution up to 80 percent of the project cost. Loans are also available for public works and development facility projects. These loans may pay the full cost of a project and may run for as long as 40 years, the interest being determined by government borrowing costs. A community that is unable to raise its share of the eligible project cost may receive a grant for 50 percent or more of the project and a federal loan for the remainder of the cost.
	Mass. Water Resources Commission, municipalities, other units of government	Water Favorability Studies - Under General Laws Chapter 21, Section 9, this program provides for studies of water favorability in areas of the Commonwealth where there may be a need for such a determination. Upon application of a county, conservation district or upon joint application by two or more municipalities, fire districts or water districts or regional district planning commissions, the Water Resources Commission may contract with any agency of the United States or with private firms to conduct water favorability studies within the jurisdictions indicated in the application. The applicants must provide one-half of the nonfederal cost, and special funding must be provided by legislation for the remainder.

TABLE 5.29 - cont. EXISTING PROGRAMS

Subject	Agency	Law or Program
Water Supply cont.	Mass. Water Resources Commission, municipalities, other units of government - cont.	Massachusetts General Laws, Chapter 767, Acts of 1970, authorizes the Water Resources Commission to acquire water impoundment sites to meet the future water resource needs of the Commonwealth.
	Environmental Protection Agency, municipalities	Drinking Water Supply-Technical Assistance - Under provisions of the Public Health Service Act (PL 93-523, as amended) the Environmental Protection Agency assists state and local water supply regulatory agencies and public water supply regulatory agencies and public water supply operators and officials to assure that water supply systems serving the public meet minimum National standards for the protection of public health.
	Farmers Home Administration, municipalities	Water and Waste Disposal Systems for Rural Communities - These loans and grants may be used for the installation, repair, improvement, or expansion of a rural water system including distribution lines, wells and pumping facilities. Installation, repair or improvement of a rural waste disposal system are also included. Loans may not exceed $20,000,000. Grants are limited to $1,000,000.
Recreation	Farmers Home Administration, landowners	Recreation Facility Loans - These loans are intended to assist farm owners to convert all or portions of their farms to income-producing outdoor recreational enterprises to supplement farm income. Funds may be used to: (1) develop land and water resources, (2) repair and construct buildings, (3) purchase land, equipment, livestock, and related recreation items. Recreation enterprises that may be financed include: campgrounds, horseback riding stables, swimming facilities, shooting preserves, nature trails, and lakes and ponds for boating and fishing. Loans cannot exceed $100,000.
		Massachusetts General Laws, Chapter 27, Section 17C - The act limits the liability of landowners who allow recreational use of their property by the public. The obvious purpose of the act is to eliminate the liability that serves as a deterrent to providing recreational opportunities and which encourages the posting of land against trespass.
	U.S. Forest Service, Mass. Division of Forest and Parks, landowners	Recreation System of the Forest Service Renewable Resources Program assists landowners to provide forest land recreation opportunities. See the Land Use - Forest Land Section for more details on the Renewable Resources Program.

TABLE 5.29 - cont.

EXISTING PROGRAMS

Subject	Agency	Law or Program
Recreation cont.	Mass. Department of Environmental Management	An Act to Protect Scenic and Recreational Rivers and Streams - This act authorizes the Commissioner of Environmental Management to adopt, amend, or repeal orders regulating or prohibiting dredging, filling or altering scenic and recreational rivers and streams. A Pilot Program under this act is being developed for the North River.
	Mass. Division of Conservation Services, municipalities	Massachusetts Conservation "Self-Help" Act (G.L. Chapter 132A, Section 11 as amended) - The Massachusetts "Self-Help" Program makes funds available to communities for acquiring conservation-recreation lands. Improvements on land acquired with the help of the Self-Help Program, may include such things as informal playfields, trails, access roads comfort stations, water impoundments, or wells and campsites. Reimbursements are available only to those municipalities which have established conservation commissions by accepting the provisions of Chapter 40, Section 8C of the General Laws. In addition, a Natural Resource Open Space-Recreation Plan must be filed with the Division of Conservation Services. The land must be controlled by the Conservation Commission after purchase by the community and accessible to any resident of the Commonwealth. An approved project may receive up to 50 percent of the cost of acquisition. If the community is also receiving federal funding assistance under a federal program, the addition of Self-Help funds may involve reimbursement of up to 75 percent of the total cost of the project.

NOTES

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3. Black, John Donald, The Rural Economy of New England: A Regional Study, Harvard University Press, Cambridge, Massachusetts, 1945, p. 383.

4. 1974 Census of Agriculture, Massachusetts.

5. Platt, Rutherford H., Sarah Fernandaz, and Lynn Reynolds, The Fertile Crescent of Massachusetts, Farmland Policy Issues of the Connecticut River Valley, Land Use Advisory Service of the Connecticut River Watershed Council, Inc., December 1975, p. 7.

6. Barlowe, Raleigh and Theodore R. Atter, Use-Value Assessment of Farm and Open Space Lands, Michigan State University Agricultural Experiment Station, Research Report 308, East Lansing, Michigan, September 1976, pp. 30-31.

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8. Kingsley, Neal P., "The Forest Landowners of Southern New England," USDA Bulletin NE-41, 1976.

9. New England River Basins Commission, The River's Reach, A Unified Program for Flood Plain Management In the Connecticut River Basin, December 1976.

10. North Atlantic Regional Water Resources Coordinating Committee, North Atlantic Regional Water Resources Study, Appendix Q, Erosion and Sedimentation, May 1972, p. Q-3.

11. These standards were first established by the Massachusetts Division of Water Pollution Control in 1967. The standards in effect now were adopted in May 1974 and published in "Rules and Regulations for the Establishment of Minimum Water Quality Standards and for the Protection of the Quality and Value of Water Resources," Commonwealth of Massachusetts, Water Resources Commission, Division of Water Pollution Control, May 1974. Classifications based on the 1967 Standards remain in force until reclassified under the 1974 Standards.

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16. "Endangered and Threatened Wildlife and Plants," Federal Register, Volume 42, No. 135, July 14, 1977.

17. Taubert, B. D., "The Biology of the Shortnose Sturgeon in the Connecticut River. Progress Report for Endangered Species Act Permit #E12" (unpublished). Abstract in Biennial Report, January 1, 1975 - December 31, 1976, Connecticut River Fish Restoration Program, U.S. Fish and Wildlife Service, Hadley, Massachusetts.

18. Lanse, R. I., "Angler Caught Adult Atlantic Salmon, Salmon River," United States Government Memorandum from Coordinators Connecticut River Anadromous Fish Program, Hadley, Massachusetts, May 10, 1977.

19. Massachusetts Division of Fisheries and Game. "Statewide Small Game Harvest," Federal Aid Project W-35-R, Progress Report, 1971.

20. Wetland types are taken from Wetlands of the United States by S. P. Shaw and C. G. Fredine, Circular 39, Fish and Wildlife Service, U.S. Department of the Interior, U.S. Government Printing Office, Washington, D.C., 1971.

21. MacConnell, W. P., Remote Sensing 20 Years of Change in Hampshire County Massachusetts, 1952-1972. Massachusetts Agricultural Experiment Station, University of Massachusetts at Amherst, Massachusetts, 1975.

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CHAPTER 6

FUTURE-WITHOUT-PLAN CONDITION

6.1 DEFINITION AND USE

The Principles and Standards for Planning include a major step to "evaluate resource capabilities and expected conditions without any plan." This involves an appraisal of future economic and environmental conditions expected without a plan, so that these conditions may be compared with those desired for the planning area.

Thus, for a selected future date, projections are made which reflect the inventory and capabilities of the natural resources, the trends which are likely to continue into the future, and the effects of any authorized projects which may alter conditions in the region. The "without-plan" portion of the title implies that the future conditions are to be projected without consideration of any projects which may be in planning stages. This restraint makes it possible to project future conditions which could be expected in the absence of any new programs or projects. Obviously, it makes little sense to embark on an elaborate planning process followed by detailed implementation schemes, if existing authorized projects combined with expected changes will meet the projected demands in a resource area.

The Massachusetts Water Resources Study is concerned with projecting future conditions in the year 1990.

6.2 IMPLICATIONS OF ECONOMIC AND SOCIAL PROJECTIONS TO ENVIRONMENTAL CONSIDERATIONS

As Chapter 4 pointed out, 1990 population projections show an increase of 76,682 or nearly 10.2 percent greater than the 1975 population of 749,646. Economic activity is also projected to increase. The potential impact on the environmental quality in the region need not be adverse. Taking the 1990 land use projections, and subtracting the prime agricultural land, lands of state and local importance for agriculture (including forest land presently located on these lands), wetlands, and water, 1,299,564 acres remain which are conducive to development. This figure would have to be adjusted downward to take into consideration slopes and soil conditions not amenable to development or septic systems. On this

basis, it is concluded that enough land resource exists to adequately support future population and economic growth. What is required is land use control or guidance to insure that future developments do not adversely impact on environmental quality.

6.3 DESCRIPTION OF FUTURE-WITHOUT-PLAN CONDITION

6.3A Agricultural Land

As noted in Chapter 4, existing land use laws and regulations have been incorporated in the projections. The statutes that appear to be the most effective are those that have preservation as their primary objective. This explains, in part, why wetland projections show a small decline relative to the historical trends. Agriculturally related land use laws seem to have little effect on the losses of such land; thus, the historical trend was adjusted only to weigh the recent trends more heavily than the earlier trends.[1/] It should be noted that, if current trends continue, the region will continue to lose agricultural land.

In December of 1977, the General Court of Massachusetts enacted legislation which would provide $5,000,000 to support a pilot development rights program wherein rights are purchased from private landowners.[2/] The impact upon agricultural land preservation could be significant if there was a long term application of such a program. For example, ownership costs (taxes) would be lower because assessments would be based upon agricultural production value rather than market value for developable land. Since development would not be permitted, farmland would be less costly to purchase which would result in lessening the barriers to entry.

With respect to stated public policies and goals regarding agricultural preservation and proper siting of future developments, the future is cloudy, at best. Subdivision control statutes are limited, since approval is not required if such developments occur along existing public roads. Unless additional controls are incorporated, land use guidance will not be forthcoming and, thus, there is some possiblity that the resource base and the environment may be adversely effected.

6.3B Forest Land

To determine the future without condition, it was assumed that forest land area will remain at its present level, and that forest management efforts will continue at the 1976 level which approximates 259,000 acres.

Wood Products -- Future urban development on forest land will decrease wood product production. Sites that are the best for growing trees are also the best for development. These sites will be the first to be lost to urban expansion and the future productivity of the region will decrease. Only 19 percent of the trees removed in land clearing operations are utilized for forests products.[3/] So this land clearing does not contribute significantly to wood product production in the region.

With no new programs to provide incentives and to educate landowners on forest management, they will continue to let their trees grow unmanaged. These landowner attitudes will discourage new industries from coming into the region, and there will continue to be a lack of markets for the low quality products.

Fuelwood harvesting will increase because of the energy crisis.

Future wood product production should remain constant or increase slightly, given the above assumptions. The harvest will remain at about 8,000,000 cubic feet per year which will affect about 13,700 acres of forest land annually.

Water -- As long as an acre of land is in forest cover and a good forest floor is present, it will produce good quality water. Forest land will remain the dominant land use in the region; therefore, the forest resource will continue to contribute to a good supply of high quality water.

Forage -- Grazing of livestock on forest land is not a major use now, nor will it become a major use in the future.

Wildlife -- The amount and kind of wildlife available in an area depends on the habitat in the area. The majority of the land area is forested, and there are many wetlands to provide diversity needed for good habitat. This is expected to continue into the future.

With the small amount of harvesting taking place, the forests will mature, and this will change the kind of wildlife found in the area. As one stage of forest succession goes to another, the animal community associated with the first also gives way to a new community.

Even though wildlife will remain in the region, access to the wildlife for both consumptive and nonconsumptive uses will continue to be a problem. As the area becomes more urban and ownerships become smaller, there will be more posting of land.

Recreation -- Future recreation needs will not be fully met through the year 1990.[4/] The forest land has the physical capacity to support the development of almost any required number of campsites, picnic areas, and trails. The problem will continue to be one of public access and an insufficient number of developed facilities. (See Table 7.5)

6.3C Flooding

As a result of the National Flood Insurance Program, many communities in the region are adopting land use regulations which will severely restrict the development of flood prone areas. Flood plain development in towns which are not enrolled in the Flood Insurance Program will be limited by the unavailability of federally supervised mortgage money in flood prone areas. In addition, communities are becoming more cognizant of the importance of flood plain management to discourage improper land use.

As a consequence of the situation stated above, flood damage potential in most of the Connecticut River Region is not expected to significantly increase by 1990. Changes could occur in individual subwatersheds, if unexpected industrial or commercial development were to occur in the old mill buildings which are located along the region's rivers. Inflation will, of course, increase the total dollar damage potential (Table 6.1), but the physical damage potential is expected to remain essentially unchanged.

There are two exceptions to this "future-without-plan" condition. The first is the Upper Quaboag River Watershed Project (subwatershed CP-32). The project has been approved but will be modified from the original plan. The expected final project will include a single purpose floodwall, two single purpose floodwater retarding structures, two multipurpose floodwater retarding and fish and wildlife structures, one multipurpose floodwater retarding and water supply structure, and one multipurpose floodwater retarding and recreation structure. At this time, four structures and the floodwall have been completed. Final completion of this project under PL-566 will significantly reduce flood damage potential in the Upper Quaboag River Watershed.

The second exception is the West Branch of the Westfield River Watershed Project (WE-38). This is an approved PL-566 project consisting of two sections of channel improvement, two single purpose floodwater retarding structures, eight multipurpose floodwater retarding and fish and wildlife structures, and one multipurpose floodwater retarding and recreation structure. Minor modifications to the original plan are being considered but have not been totally resolved.

It should also be noted that the Bradley Brook Watershed (WE-40) is an approved PL-566 project. The original project called for one multipurpose floodwater retarding and water supply structure, one multipurpose flood-water retarding and recreation structure, and one section of channel improvement. At this time only the multipurpose floodwater retarding and water supply structure has been completed. Geology and engineering investigations undertaken after the initial work plan approval indicate lack of engineering feasibility for the remaining measures.

TABLE 6.1 PROJECTED 1990 FLOOD DAMAGES 1/

Subwatershed	100-Year Flood Damage	Average Annual Damage
-Deerfield Study Area-		
DE-10 (Green River)	318,600	7,600
DE-11 (Deerfield River)		2/
DE-12 (Cold River)	2,754,000	137,000
DE-13 (Chickley River)	300,000	15,000
DE-14 (Clesson Brook)	255,000	12,200
DE-15 (North River)	517,900	20,000
DE-16 (Deerfield River)	140,000	11,700
DE-60 (North River - East Branch)		2/
-Northern Connecticut Valley Study Area-		
NC-7 (Ashuelot River)		2/
NC-8 (Pauchaug Brook)		2/
NC-9 (Falls River)		2/
NC-59 (Broad Brook)		2/
-Millers Study Area-		
MI-1 (Otter River)		2/
MI-2 (Millers River)	1,350,000	25,800
MI-3 (Tully River)		2/
MI-4 (Millers River)		2/
MI-5 (Moss Brook)		2/
MI-6 (Keyup Brook)		2/
-Westfield Study Area-		
WE-36 (Westfield River)		2/
WE-37 (Westfield River-Middle Branch)		2/
WE-38 (Westfield River-West Branch)	360,000	7,100
WE-39 (Westfield River)	10,746,800	644,800
WE-40 (Bradley Brook)	1,885,300	84,500
WE-41 (Russell Brook)		2/
WE-42 (Little River)	3,816,900	229,000
WE-43 (Munn Brook)	172,500	9,900
WE-44 (Powdermill Brook)		2/
WE-45 (Great Brook)		2/
WE-46 (Paucatuck Brook)	418,600	30,900
-Farmington Study Area-		
FA-52 (Salmon Brook)		2/
FA-53 (Upper West Branch-Farmington River)		2/
FA-54 (West Branch-Farmington River)		2/
FA-55 (Clam River)	390,000	23,400
FA-56 (West Branch-Farmington River)		2/
FA-57 (Sandy Brook)		2/
FA-58 (Upper East Branch-Farmington River)		2/

TABLE 6.1 - cont. PROJECTED 1990 FLOOD DAMAGES 1/

Subwatershed	100-Year Flood Damage	Average Annual Damage
CV-17 (Russellville Brook)		2/
CV-18 (Sawmill River)		2/
CV-19 (Mill River)	124,000	6,500
CV-20 (Mill River)		2/
CV-21 (Fort River)		2/
CV-22 (Mill River)	622,600	48,100
CV-23 (Broad Brook)	1,244,200	149,300
CV-24 (Manhan River)	79,000	17,600
CV-25 (Bachelor Brook)		2/
CV-26 (Stony Brook)		2/
-Chicopee Study Area-		
CP-27 (Quabbin Reservoir)		2/
CP-28 (Swift River)	200,000	12,000
CP-29 (Ware River)		2/
CP-30 (Danforth Brook)	277,000	16,600
CP-31 (Ware River)		2/
CP-32 (Upper Quaboag River)	330,300	54,500
CP-33 (Lower Quaboag River)	157,600	9,500
CP-34 (Twelve Mile Brook)		2/
CP-35 (Chicopee River)	172,500	10,400
-Southern Connecticut Valley Study Area-		
SC-47 (Mill River)		2/
SC-48 (Longmeadow Brook)		2/
SC-49 (Freshwater Brook)		2/
SC-50 (Stony River)		2/
SC-51 (Scantic River)		2/

1/ Price Base 1976. Main Stem Connecticut River damages are excluded.
2/ Average Annual damages are less than $5,000.

6.3D Erosion and Sediment

It is expected that the ongoing programs of the conservation districts along with cost-sharing assistance available to operators through the programs of the Agricultural Stabilization and Conservation Service will be sufficient for the erosion problems associated with:

1. Forest land;

2. all agricultural land except tilled cropland without adequate land treatment;

3. urban land including recreational lands;

4. other lands including abandoned fields and power line rights-of-way.

Gravel pits and roadbanks are not significant erosion problems in the region because of efforts and existing programs of municipal and state agencies.

The erosion problems which present programs do not adequately treat are:

1. Tilled cropland;

2. construction sites, areas undergoing urban development;

3. streambanks.

6.3E Wetlands

The future status of wetlands loss in the region will in large measure be determined by the effectiveness of the Wetlands Protection Act and the Inland Wetlands Restriction Acts. The ownership and zoning of the wetlands will also be a factor in determining the potential for loss of wetlands.

Wetlands Protection Act applications have been reviewed for a sample of 85 communities in the state. The sample indicates that in 1976, nearly 290 acres of the 80,800-acres of inland wetlands in the sampled communities had received alteration permits. An analysis of building permit data for the last 10 years showed that construction expenditures for 1976 were being made at a rate nearly 15 percent above the 10-year average. In view of this, the 1976 loss of inland wetlands figure, approximately 0.4 percent per year, is considered appropriate for use here.

Publicly owned wetlands are in less danger of being lost to development than privately owned areas. Surveys of the inland wetland areas indicated over 18 percent were owned by government or some quasi-public body, such as the Massachusetts Audubon Society or Trustees of Reservations. Zoning can also affect the rate of wetland loss. Conservation and flood plain zoning of wetlands will tend to preserve wetland areas, while industrial or commercial zoning indicates a potential danger to the wetlands. About 8,000 acres or 11.6 percent of the inland wetlands were zoned for conservancy (flood plain, wetlands, conservation, etc.).

Considering historical wetland losses, adjusted for variations in construction activity and factoring in the effects of public ownership and protective zoning, indicates a projected loss for inland wetlands of about 3,900 acres between 1977 and 1990.

Discussions with personnel involved with the Inland Wetland Restriction Program indicated that if the program continues at the present rate, restrictions will not be imposed in the Connecticut River Region by 1990. Approximately 13 towns in eastern Massachusetts have had their inland wetlands restricted under this program. Also, an additional 11 towns are in process at this time. The present and projected status of wetlands are given in Table 6.2.

TABLE 6.2 1990 INLAND WETLANDS SITUATION & PROJECTIONS

Item	Acres	Percent of Total
Present status (1977)	69,603	100.
Wetlands in:		
Public or quasi-public ownership	12,794	18.4
In conservancy zones1/	8,060	11.6
G.L., Ch. 131, Sec. 40A restrictions on privately owned wetlands	0	0
Wetlands protected only by G.L., Ch. 131, Sec. 40 in 1977	48,789	70.0
Projections (1977 to 1990)		
Additional public acquisition	6,000	8.6
Additional Ch. 131, Sec. 40A restrictions	0	0
Projected loss of wetlands by development	3,900	5.6
Wetlands protected only by G.L., Ch. 131, Sec. 40 in 1990	38,849	55.8

1/ Does not include wetlands in public or quasi-public ownership.

6.3F Water Supply

The draft Massachusetts Water Supply Policy Study report concluded that 24 towns (26 percent) of the region will have a surplus of water in 1990. Thirteen towns (14 percent) with public water systems will have a deficiency. Deficiencies range from less than 1 million gallons per day (mgd) for 8 towns to over 5 mgd for West Springfield. Adequate supply data was not available for 26 towns with public systems. Thirty-one towns or 33 percent of the region use private individual systems and no predictions were made for these towns. Proposals have been presented to alleviate some of the deficiencies by improving distribution systems, promoting conservation of water, exploring for ground water resources, and by possible utilization of additional surface water storages. Though various studies and proposals have been made, few actual commitments have been made which will have any far-reaching effects on the predicted shortages.

The Massachusetts Executive Office of Environmental Affairs has just completed a "Water Supply Policy Study" for the state. The study utilized available data whenever possible and updated population projections and safe yield estimates. Those desiring detailed water supply data should refer to this study.

The Massachusetts Water Supply Policy Study recommends the following be established as the Commonwealth's policies for water supply:5/

Supply Management Policies

It is the policy of the Commonwealth to:

1. Require that water utility systems and those concerned with private supplies of water continue to give paramount consideration to health and safety needs. High priority should be given to insuring that water supplies are developed to meet such needs, particularly where imbalances exist and where a complementary demand management policy is in effect.

2. Guide and control supply planning by water utilities through conditional grants, financial incentives, and state review and approval procedures.

3. Encourage and assist water utilities to draw upon water sources within their own watersheds. Before allocation of the water resources of any of the Commonwealth's 12 major watersheds for interbasin transfer, the receiver shall demonstrate, pursuant to the Massachusetts Environmental Policy Act, that environmental effects are within acceptable limits; that local options have been exhausted, including efforts to preserve and restore potential ground and surface water supplies within the acquiring

basin, and to maintain and restore the function of watershed areas; and that effective water conservation measures have been established.

4. Encourage the planning of local water supplies and watersheds to include, when consistent with Policy 4.C.1.1., multiple uses such as recreation, fish and wildlife habitat maintenance, protection of natural systems, and enhancement of aesthetic values.

5. Establish standards for and monitor minimum stream flows and pond or lake levels, and regulate withdrawals of ground and surface water to assure preservation of water-dependent natural areas, coordinating the monitoring of interstate streams with other states.

6. Encourage and assist water supply utilities to: develop or expand existing and new groundwater resources prior to seeking additional surface supplies; develop the multiple use potential of new and existing surface supplies in a manner consistent with Policy 4.C.1.1., such as establishing adequate facilities for treatment of the water; acquire, protect for quality, and manage the recharge of groundwater areas and watersheds to the extent necessary to postpone treatment as far as possible; and enhance potability and avoid contamination through the rehabilitation and improvement of supply facilities.

7. Include desalination as an integral part of long-range supply planning.

Demand Management Policies

It is the policy of the Commonwealth to:

1. Require statewide water conservation efforts, including the use of water saving appliances in all new construction, maximization of industrial and commercial multiple usage of water, and reduction of evaporative uses where feasible. Require the MDC, and all regional and local water suppliers to institute mandatory conservation measures consistent with the statewide water conservation program, applying to those efforts the criteria of achievement of such estimates of minimum water needs as the state, through the Water Resources Commission, may establish.

2. Require metering of all water utility deliveries and accelerate programs to install, maintain and replace meters in all local systems, giving priority to systems having the greatest amount of unaccounted-for water.

3. Require the rehabilitation of supply and distribution facilities which show large quantities of unaccounted-for water.

4. Encourage and assist water utilities to promote recycling of industrial process water and renovated municipal wastewater.

5. Require the Water Resources Commission to study water rates set by all publicly and privately owned utilities and recommend legislation on pricing, consistent with state water policy.

Administrative Management Policies

It is the policy of the Commonwealth to:

1. Encourage new programs and new financial commitments by the federal government in support of state and local comprehensive water resource planning, protection, and management activities. Such federal programs for water resources should be of the "block-grant" type permitting maximum flexibility to state governments in their formulation and administration.

2. Centralize department-level water resources planning, policy making and implementing in a single agency charged with the following responsibilities:

   - to prepare and maintain an assessment of water resources by watershed areas;

   - to coordinate and guide watershed planning;

   - to administer technical assistance and grant programs;

   - to prepare "water budgets" and plans for all water uses, including recreational waters;

   - to advise the Secretary of Environmental Affairs on water rights and water allocation questions;

- to develop a formal process to deal with interbasin transfers and recommend agreements acceptable to all parties in specific interbasin transfer cases;

- to monitor stream, pond, lake and aquifer withdrawals and the treatment thereof;

- to review local water rates;

- to develop and maintain an ongoing community liaison program; and

- to regulate and administer such other matters as may affect the public health, safety, and welfare.

3. Until the establishment of a centralized water resources agency, authorize and direct the Water Resources Commission to take the following high priority actions to:

   a. Initiate a statewide water conservation program.

   b. Provide technical assistance to local communities, particularly for monitoring the quality of all water supplies, for advising on local supply options, for securing federal and other grant programs, and for conducting conservation programs.

   c. Initiate state level responsibilities for broad, long-range water supply planning, coordinating with regional planning agencies, and using defined watershed areas for basic analysis.

   d. Institute a process which effectively provides for public input in the review and arbitration of water rights questions among competing uses and users; in advising the legislature on questions of water allocation among communities; and in studying and recommending changes needed to administer state policy.

   e. Establish a process for planning and development of water resources and related activities at the local, regional, and state levels which involves citizens and which assures full review and consideration of environmental factors and values, land use controls, and techniques and institutional procedures (such as advance land acquisition) to minimize future costs and disruptions associated with development.

Assure that the Secretary of Environmental Affairs, in designated areas of critical environmental concern, considers water resources and water supply values.

f. Encourage regionalization of water supply systems where necessary, following standards of economic and technical feasibility, and in accordance with state growth, environmental protection, and water policy.

Information concerning potential surface water reservoir sites which appear to be suitable for development as municipal water supply reservoirs is found in Appendix A.

6.3G Water Quality

The Federal Water Pollution Control Act Amendments of 1972 have as an objective the restoration and maintenance of the chemical, physical and biological integrity of the nation's waters. To achieve this objective, two major goals were established: (1) to attain swimmable-fishable waters by 1983, and (2) to achieve zero discharge of pollutants by 1985.

Point sources of pollution have been the major emphasis of the clean-up efforts to date. Millions of dollars have been, and will continue to be spent to meet the enormous costs involved in constructing and operating wastewater treatment plants.

Although the objective of the 1972 Amendments to the Water Pollution Control Act will be difficult and expensive to achieve public sentiment for clean water is overwhelming. Major pollution problems still exist in the main stem of the Connecticut River and the Westfield and Millers Rivers.

Alternatives for meeting the remaining water quality problems are presented in detail in Water Quality Management Plans prepared for the Millers, Westfield, Chicopee, Deerfield, Farmington and Connecticut Rivers by the Massachusetts Division of Water Pollution Control.

The subject of water quality will not be considered further in this report except when it overlaps another concern such as land use, or erosion and sediment. These areas of overlap will be restricted to the water quality effects of nonpoint pollution sources and alternatives for minimizing the problem.

Water Quality Management Plans prepared under Section "208" of the Federal Water Pollution Control Act will have only a minimal effect on meeting water quality goals in the region, since only two towns are in designated areas for the program. Nonpoint pollution in the remainder

of the region will receive very limited attention without additional funding. Efforts will likely be limited to identifying major problem areas in this nondesignated area.

6.3H Recreation

Recreational planning in Massachusetts is guided by the Statewide Comprehensive Outdoor Recreation Plan (SCORP) which projects demand figures to the year 2000. Supply figures, however, are based upon currently available facilities. Comparison of 1990 demand figures with present supply indicates an unmet demand in hiking, swimming, camping, and picnicking. Alternatives will be presented in a later chapter which offer potential to meet some but nowhere near all of the projected needs.

Of the 100 natural areas in the Connecticut River Region identified by the 1974 Massachusetts Landscape and Natural Areas Survey, 53 are now owned by public or private conservation organizations or institutions. By 1990, it is expected that an additional seven sites will be acquired or protected, making a total of 60 sites in a protected status.

Historical and cultural sites in the region are more than adequately identified and protected by ongoing efforts of federal, state, and local governments and private individuals and organizations.

As the USDI, Bureau of Outdoor Recreation suggests in the 1970 Connecticut River Basin Study, certain streams in the region should be included in a basinwide, but nonfederal, wild, scenic and recreational river program. Massachusetts has a Scenic and Recreational Rivers program under which the Department of Environmental Management is now inventorying the scenic and natural qualities of the waters and streams of Massachusetts. The state program appears to be the most logical mechanism for designating the region's rivers and streams as scenic or recreational rivers. At this time, because of uncertainty about implementation of the program, we have assumed that no rivers will be protected under the act for the "future-without project" conditions.

Public access to ponds and lakes in the region should be increasing in the future although the magnitude of this increase is difficult to quantify. Conservation commissions are actively seeking to acquire prime areas, many of which are wetlands or include fresh open water. Appendix C indicates the access status of public lakes, ponds, and reservoirs. There have been suggestions made that the Public Access Board should be making a greater effort to acquire formal public access to the Great Ponds of the state. The Wetlands Protection Act, Chapter 131, Section 40, should be effective in preventing loss or harmful alteration of fresh open water areas. The Act is administered by local conservation commissions that are becoming more and more sophisticated and careful in issuing alteration permits.

6.31 Fish and Wildlife

According to the Division of Fisheries and Wildlife, demand for fish and wildlife recreational opportunities over the next 25 years will increase but to an unknown degree dependent upon various positive and negative factors which are impossible to predict. Participation in hunting and fishing, however, is expected to increase at an average rate of one-half percent per year. Participation in nonconsumptive fish and wildlife recreational activities will likely increase under the stimulus of a state "nongame" program when such is established, and continued publicity involving rare and endangered species.

It is anticipated that the larger game mammals, waterfowl, raptors, upland game, and songbirds will continue to receive major public attention and support. Reptiles, amphibians, rodents, various less visible species, and those animals viewed as pests are expected to attract only minor attention.

PHOTO by Jack Swedberg
Mass. Division of Fisheries & Wildlife

Ruffed Grouse, usually called "partridge" in the region, are a favored upland game specie.

NOTES

1/ It should be pointed out that the historical land use data in Chapter 5 are not comparable to the projected land use figures. The reason for this is that Chapter 5 data are based upon W. P. MacConnell's Map Down Project whereas the projections are based upon agricultural census data. The latter source of data utilizes a much more restrictive definition as to what is defined as a farm (a productive unit with some minimum amount of sales), thus the acreage is less than that in the Map Down interpretation.

2/ Agricultural Preservation Act, Massachusetts General Laws, Chapter 780 of the Acts of 1977.

3/ Kingsley, Neal P., The Timber Resources of Southern New England, USDA, Forest Service, Resource Bulletin NE-36, 1974.

4/ Massachusetts Department of Environmental Management, Massachusetts Outdoors Statewide Comprehensive Outdoor Recreation Plan, 1976.

5/ Massachusetts Executive Office of Environmental Affairs, Massachusetts Water Supply Policy Study, January 1977, Boston, Massachusetts.

CHAPTER 7

NEEDS

7.1 INTRODUCTION

Needs may be defined as the unmet demand which will not be satisfied by existing resource management or by implementation of authorized plans or project. The quantification of needs stems from the evaluation of resource capabilities and expected conditions without a plan. In effect, needs indicate the areas where additional planning, authorization, and implementation is needed to meet the desires of society.

7.2 LAND USE NEEDS

7.2A Agricultural Land

Table 7.1 summarizes the needs as determined from the future-without-plan condition relative to the stated problems and objectives. The primary need is to maintain or increase agricultural land. As Table 7.1 also shows, there are a number of subneeds that must be met in order for the primary need to be satisfied.

An interesting aspect within the land resource area is that, by solving the NED problem, much of the identified EQ problem (loss of open land) is also solved. Thus, the needs for the EQ objective in the land resource area are similar to those of the NED objective. There is some dichotomy, however, in that one of the objectives is to increase or, at least, maintain agricultural production. But if this is accomplished, the water resource quality may be adversely effected by continuing or increasing levels of nonpoint sources of pollution. Thus, as Table 7.1 summarizes, there is a need for an aesthetically pleasing land use mix, and if such a mix is derived from a continuation of agriculture, then there is another need to minimize nonpoint sources of pollution from agriculture.

One of the most important regional needs is to complete the soil survey. These surveys are extremely useful in providing an inventory of soil types, providing soil interpretations for guiding land use decisions, providing critical area locations, identifying prime agricultural land, and proposing management programs.

TABLE 7.1 AGRICULTURAL LAND USE NEEDS

Primary Objectives	Resource Area	Needs
NED	Agricultural Land	1. Reverse trend of agricultural land loss and thus maintain or increase agricultural income.
		2. Insure proper land use planning to minimize future development on agricultural land.
		3. Complete soil surveys.
EQ	Open Land	1. Locate future developments so as to minimize locations on environmentally sensitive areas.
		2. Complete soil surveys.
		3. Preserve open land to contribute to an aesthetically pleasing land use mix.
		4. Minimize nonpoint pollution agricultural sources.

7.2B Forest Land

By the year 1990, there will be a need for an additional 14.4 million cubic feet of wood products from the region. Forest land needs are summarized in Table 7.2.

The first step in increasing production is to improve the management on public and private forest land for wood products. There will also be a need to increase the acreage of forest land managed for wood products.

Many landowners require incentives to persuade them to manage and not develop their land for other uses. If a landowner is going to manage his land for forest products, he has to see the possibility of selling his products. There is a need to develop diversified markets. To increase management on private forest land, many owners need to be informed of the opportunities and benefits of forest management.

Additional needs beyond the scope of the material included in this report are areas of study that would complement and strengthen the forestry sectors. At the present time, the secondary wood-using industries reportedly draw nearly all their requirements for wood from areas outside the state. There is a need to study the structure of these industries with a goal of supplying more of their needs from in-state milling plants.

TABLE 7.2 FOREST LAND NEEDS

National Objective	Resource Needs	Needs	
		1980 12.1 Million Cubic Feet	1990 14.4 Million Cubic Feet
NED	Forest land	Increase the management of public and private land for wood products from the present 259,000 acres to 723,000 acres. Increase incentives to landowners to manage their forest land. Develop diversified markets for wood products. Inform and educate landowners on the values of forest management.	
EQ	Forest land	Information and education program on forest land. Provide technical services on forest land management.	

To increase or maintain the environmental quality of the area, there is a need to combine the urban and forest environments in a way that maintains some of the benefits of the forest environment. This can be accomplished by first informing towns about urban forest management, and, secondly, providing technical assistance to towns to manage their urban forest lands.

7.3 FLOODING

One of the objectives of this study of flooding is to develop alternatives to reduce flood damages to an acceptable level. The definition of "acceptable level" is subject to discussion. For purposes of this study, however, average annual flood damage of less than $5,000 was considered an acceptable level.

This is roughly equivalent to a 100-year frequency flood causing $80,000 in damage. Subwatersheds expected to need alternatives to reduce flood damage are indicated in Table 7.3.

TABLE 7.3 FLOOD DAMAGE REDUCTION NEEDS

Subwatershed	Description	Average Annual Damage[1/]
DE-10	Green River	7,600
DE-12	Cold River	137,000
DE-13	Chickley River	15,000
DE-14	Clesson Brook	12,200
DE-15	North River	20,000
DE-16	Deerfield River	11,700
MI-2	Millers River	25,800
WE-38	Westfield River - W. Branch	7,100
WE-39	Westfield River	644,800
WE-40	Bradley Brook	84,500
WE-42	Little River	229,000
WE-43	Munn Brook	9,900
WE-46	Paucatuck Brook	30,900
FA-55	Clam River	23,400
CV-19	Mill River	6,500
CV-22	Mill River	48,100
CV-23	Broad Brook	149,300
CV-24	Manhan River	17,600
CP-28	Swift River	12,000
CP-30	Danforth Brook	16,600
CP-32	Upper Quaboag River	54,500
CP-33	Lower Quaboag River	9,500
CP-35	Chicopee River	10,400

1/ Price Base 1977.

7.4 EROSION AND SEDIMENT

Major erosion and sediment control needs are concentrated in three areas: construction projects, about 6,000 acres of tilled cropland, and streambanks.

7.4A Areas Undergoing Urban Development (construction sites)

From 1952 to 1972, approximately 4,400 acres per year of nonurban land were converted to urban use. During the construction period, soils are usually stripped of vegetative cover and are often left in this exposed condition for extended periods of time. The result can be severe erosion on the site and quantities of sediment released downstream. It is expected that 4,400 acres per year will be converted to urban use by 1990. Gross erosion from these areas is expected to exceed 310,000 tons per year.

7.4B Tilled Cropland

Erosion rates on approximately 20 percent of the tilled cropland exceeds the average tolerable loss of 3 tons per acre established for most soils. These high soil losses are due to cropping on moderate and steeper slopes with inadequate or no land treatment measures. Cropland treatment needs are good management and the use of good practices such as residue and cover, sod in rotation, contouring, strip cropping, and terraces. About 6,000 acres will require sound management and treatment by one or more of the preceeding practices. Some of this acreage will require a return to a permanent vegetative cover to effectively control further erosion.

7.4C Streambanks

Streambank erosion is a major problem from the standpoint of sediment delivered to watercourses. The 248-miles of major streams and 303 miles of tributaries which are considered to be susceptible to erosion have an estimated average erosion of 340,000 tons annually. There is a need to establish vegetative buffer zones along streams where erosion is occurring, and structurally stabilize the most critical areas where vegetative methods are not adequate.

7.5 WETLANDS

According to the wetlands projections in Chapter 6, by the year 1990, over 3,900 acres of inland wetlands will be lost to urban development. An additional 38,800 acres will be protected only by General Laws, Chapter 131, Section 40, the Inland Wetlands Protection Act. There is a need to reduce projected wetland loss by providing additional protection to the 46,900-acres of inland wetlands which are not protected by public ownership, the Inland Wetlands Restriction Act or conservancy zoning.

7.6 WATER SUPPLY

Projections in Chapter 6 indicate that at least 13 towns will have a public water supply deficiency by 1990. To alleviate this problem, there is a need to: (1) reduce excessive leakage in existing distribution systems, (2) locate additional ground water sources, (3) utilize or at least preserve available surface water storage sites, and (4) discourage wasteful use through an appropriate pricing structure or other means.

7.7 WATER QUALITY

Much is being done to alleviate the water quality problems in the region. However, there is a need to reduce nonpoint pollution from sediment, onsite sewage disposal systems, and other nonpoint pollution sources. Completion of soil surveys and reduced erosion and sedimentation are needed to effectively deal with the nonpoint pollution problem. The soil surveys will provide information needed to intelligently plan residential development to avoid onsite sewage disposal problems and the potential effects on water quality.

7.8 RECREATION

Recreation needs as indicated in Table 7.4 shows a surplus in the region of canoeing and sailing facilities. However, local areas may be in need of these facilities, as their distribution does not always coincide with population.

TABLE 7.4 RECREATION NEEDS

Activity	1975 Supply (1000 Activity Days)	1990 Demand (1000 Activity Days)	1990 Need	1990 Facilities Needed Number	1990 Facilities Needed Unit
Swimming	7,127	7,981	854	9,770	beach (ft)
Camping	626	877	251	1,440	sites
Picnicking	1,966	6,614	4,648	11,090	tables
Canoeing-Sailing	3,172	650	(surplus)	-	-
Hiking	1,247	3,722	2,475	930	trails (mi)

Source: 1976 SCORP report (adjusted for the Connecticut River Region).

The need for picnicking facilities expressed as 11,000 picnic tables appears to be an unrealistic goal. In lieu of formal picnic facilities, much of the demand is now, and will continue to be, met by informal picnic sites, i.e., a blanket under a tree.

Likewise, a portion of the need for hiking trails may be met with something less than a formally mapped and labeled "trail." Utility rights-of-way, rural roads and even city streets in an historical area can serve to provide an enjoyable hiking experience.

There is also a need to meet the environmental quality objectives associated with recreation:

1. Outstanding natural areas need to be preserved.

2. Massachusetts Scenic and Recreational Rivers Act should be implemented within the region.

3. Many of the recreational recommendations of the 1980 Connecticut River Basin Plan are still applicable to the region: streambank acquisition, and nonstructural flood plain management for agricultural, recreation and open space.

SCS PHOTO

Quabbin Reservoir, a Metropolitan District Commission water supply, is one of the region's outstanding fishery resources.

CHAPTER 8

ALTERNATIVES

8.1 INTRODUCTION

Alternatives designed to meet the needs expressed in Chapter 7 are presented in this chapter for each major study concern. Table 8.4 compares the alternatives with needs and assesses the effectiveness of each alternative. Effects of the alternatives on national economic development, environmental quality, social well-being, and regional development are presented in Table 8.5. Table 8.6 summarizes the potential environmental effects of the alternatives.

8.2 LAND USE ALTERNATIVES

This section addresses the public policy alternatives that are relevant to the problems and needs identified in land use. One alternative is the continuation of present policies. Since such action would not have a positive impact on the problems and needs discussed in this report, the "without plan" alternative is omitted from further discussion.

8.2A Agricultural Land Use Alternatives

It is apparent, from recent discussions with state officials, that an overriding concern is the preservation or expansion of agricultural land in the hope that production in the agricultural sector may be maintained or increased. Related to this is the desire to maintain an attractive variety of land uses which will continue to provide a good aesthetic and environmental setting, in terms of wildlife habitat and scenic viewing.

Past measures enacted in most states, including Massachusetts, were based upon regulations (i.e., zoning ordinances) and incentives (i.e., agricultural assessments). Given the continuing trend of declining agricultural land, it is apparent that these approaches have not been effective. Regulations have been ineffective for two reasons: (1) Zoning an area agricultural does not necessarily guarantee that agriculture will be practical. (2) Those owners whose land is zoned low density have a strong economic incentive to press for zoning variances. Historically, applications for zoning variances are often approved.

The incentive or agricultural assessment approach was aimed at decreasing taxes to agricultural enterprises. Although this measure has made staying in agriculture easier, it has not precluded the selling of agricultural land to nonagricultural users, primarily because the tax penalties assessed on such transactions are small in comparison to the amounts received for those properties. An underlying thought in the preferential assessment approach is that only a little monetary assistance is necessary to keep agricultural firms viable. Little, if any, research has been undertaken to determine exactly how much help is required.

A number of states have recently been considering other means by which agricultural land might be preserved. Vermont and Washington have enacted land sales excise taxes. In Washington, for example, on land sold by an owner of six years or more, no taxes are paid. However, for an owner of less than one year who sells land, the tax amounts to 50 percent of the sales price. Vermont law is similar, though tax percentages may differ somewhat. The main purpose of these laws is to decrease speculative buying of agricultural land with the intent to sell quickly to nonagricultural uses.

A number of states, including Massachusetts, have passed legislation providing for the public purchase of development rights to agricultural land, thus precluding other uses. Such a program is a combination of the regulatory and incentive approaches. It is regulatory, in the sense that agricultural areas must be designated for preservation, and it includes incentives, since the income derived from the buying of the development rights can be reinvested in the farm enterprise to increase efficiency and net borrowing power and, thereby, hopefully increase its competitiveness. The public investment required in a development rights program is dependent upon the difference in the value of land used for agriculture and the value, if the land were used for development. Thus, in areas that are in close proximity to higher value uses, the public costs per acre of purchasing the development rights would be higher than in areas located further away. After the development rights are purchased, no other uses would be permitted. Such a program has two advantages over those previously mentioned:

1. The sale of development rights will provide compensation to owners of restricted areas.

2. Prospective farmers will require less financial resources to enter farming, since land prices will be based on agricultural earnings, rather than upon potential development values.

Table 8.1 summarizes the component needs of agricultural land and the various alternatives through which these needs may be satisfied.

TABLE 8.1 SYSTEMS FOR PRESERVING AGRICULTURAL LAND

Component Needs	A Zoning and Preferential Assessment	B Purchase Leaseback	C Development Rights	D Allotments
1. Maintain or increase agricultural production.	No	Yes	Yes	Yes
2. Maintain or increase environmental and aesthetic qualities.	No	Yes	Yes	Yes

8.2B Forest Land

Chapter 7 listed both the NED and EQ needs of the forest resource. Based on these needs, four alternatives are presented. Each of these alternatives have specific activities which, when combined, make up the major alternative. One or all of these activities could be implemented. The alternatives and accompanying activities are:

1. Increase management of public and private land by increasing the number of personnel working on state land, and personnel providing technical assistance to private landowners.

    a. Add eight foresters to provide management assistance to private landowners.

    b. Add three foresters to work on state forest lands.

    c. Add four technicians and 20 woods workers to work on state forest land.

2. Increase incentives to landowners to encourage them to utilize and manage their forest land for timber products.

    a. Increase Forestry Incentive Program money by $116,600 annually.

    b. Change Liability laws to encourage landowners to allow people on their land to cut fuelwood.

3. Establish a program to develop diversified markets for low quality products.

a. Establish one plant to utilize low quality products.

b. Hire one person to work on a marketing and utilization program.

c. Hire one person to develop a fuelwood management program.

4. Establish an information and education program to inform private landowners about the benefits of forest land management.
   a. Hire three people to conduct an information and education program throughout the region.

The EQ needs listed in Chapter 7 can also be met with the above alternatives. The information and education program can inform urban as well as rural landowners. The increases in personnel can provide technical assistance needed in the urban areas.

8.3 FLOODING ALTERNATIVES

Flood damages can be minimized by careful planning and implementation of flood plain management techniques. Flood plain management programs should contain regulatory and corrective measures.

8.3A Regulatory Measures

Regulatory measures do not prevent flooding but, instead, reduce the threat of damage or loss of life from floods by discouraging development on flood plains. Regulatory measures include flood plain regulations, development policies, land use restrictions, greenbelts or open space, flood insurance, tax adjustments and warning signs are related measures.

In order to limit flooding damage to existing properties in the flood plain Flood Plain Management Programs should be established for each study area. The National Flood Insurance Program, established on a community-by-community basis, would be a major element of any flood plain management program. All communities in the region should cooperate with the National Flood Insurance Program regulations and formulate effective flood plain restrictions, such as zoning and subdivision control.

The first flooding alternative would be to recommend that the 21 towns not now participating join the National Flood Insurance Program as a first step towards establishing sound flood plain management programs.

8.3B Corrective Measures

Corrective measures, while they do not eliminate flooding, can reduce the extent of flooding and resulting damages. These corrective measures are usually physical measures and can include land treatment, floodwater

retarding structures, stream improvements, levees or floodwalls, existing reservoir management programs, floodproofing of structures, relocation, acquisition, flood plain reclamation, and flood watch and warning systems.

As noted previously, regulation of development on flood plains is expected to effectively limit increases in flood damages. Corrective measures will also be needed to reduce damage to existing development.

Corrective measures, as described below, are usually physical measures that are designed to reduce or control floods and flood damage.

Land Treatment -- Vegetative and mechanical land treatment measures can be installed on the uplands to prevent destruction of land by erosion and reduce the movement of damaging amounts of sediment to the streams and flood plains. Agricultural lands and lands in transition from agriculture to urban uses should be protected or maintained by temporary vegetation, mulch, sediment basins, or other measures to reduce and control erosion. Land treatment measures also slow or reduce runoff and peak flood flows from upland areas.

Floodwater Retarding Structures -- These structures are earthfill or concrete impoundments that check the uncontrolled flow of floodwater rushing downstream. The structures are located to protect the largest possible area of land subject to flooding, encroach as little as possible on high value lands, and provide a high level of protection to downstream property.

Stream Modifications -- Stream channel changes to increase channel capacity to carry floodwater can be made by straightening, deepening, widening, clearing, or by lining the channel so that flooding will be less frequent and severe.

Dikes and Floodwalls -- These are earth embankments or concrete walls built along the bank of a stream to confine flood flows to the channel or floodway. Dikes and floodwalls are normally used to provide protection to high value flood prone areas.

Floodproofing of Buildings -- Techniques used to make existing buildings, contents, and grounds located in flood hazard areas less vulnerable to flood damage are:

1. Permanent measures built as an integral part of the structure, such as raising the elevation of the structure, waterproofing of basement and foundation walls, anchorage and reinforcement of floors and walls, and use of water-resistant materials;

2. contingency measures which require action to be taken to make them effective, such as, manually closed sewer valves and removable bulkheads;

3. emergency measures carried out during floods according to prior emergency plans, such as sandbagging, pumping, and removal of contents to flood-free areas.

Flood Plain Reclamation -- This includes the permanent evacuation of developed areas subject to inundation and the acquisition of lands by purchase, the removal of structures, and the relocation of the population from such areas. Such lands could then be returned to a natural wildlife habitat or used for agriculture, low intensity recreation, or other purposes which would not interfere with flood flows.

Flood Watch and Warning Systems -- The National Weather Service of the National Oceanic and Atmospheric Administration issues warnings of potential flood producing storms. Frequently, the flood warnings are preceded by a "severe weather or flood watch."

Local programs can also be implemented to give advance warning to flood prone areas of potential or impending flood danger. On small watersheds with considerable swamp storage, staff gages set at key locations could be monitored by local personnel. Monitoring could be accomplished by the use of float-activated electronic warning signals connected to the police or fire department. All warning systems should be coordinated with local Civil Defense disaster plans.

8.3C Evaluated Alternatives

Three combinations of corrective measures were investigated to illustrate the range of possibilities available to reduce existing flood damage. These combinations are presented as flooding alternatives. A summary of the combinations, costs, and remaining damages is presented in Table 8.2.

Land treatment, floodwater retarding structures, stream improvements, and dikes and floodwalls were considered as one combination. These structural measures have been the traditional basis of federally-financed flood control projects. Reduction in flood damage is achieved by reducing runoff and peak flows or by confining flood flows to established channel or floodways.

Another combination investigated was a floodproofing program to modify existing damageable property. A wide range of techniques was considered to reduce damage at individual locations. Permanent measures, such as the waterproofing of walls, were combined with contingency measures, such as removable flood barriers to safeguard interior areas from floodwaters. Emergency measures to be carried out during floods, such as pumping and removal of damageable material to flood-free areas, were also included in this alternative.

TABLE 8.2

SUMMARY OF ALTERNATIVES TO REDUCE FLOOD DAMAGE

Sub-Watershed	1990 Flood Damage 100-Year Flood	1990 Flood Damage Average Annual	Structural Alternative: Flood Damage with Project 100-Year Flood	Structural: Flood Damage with Project Average Annual	Structural: Project Cost 1/ Total Cost	Structural: Project Cost 1/ Average Annual 2/	Structural: Project Benefits Average Annual	Nonstructural Alternative: Flood Damage with Project 100-Year Flood	Nonstructural: Flood Damage with Project Average Annual	Nonstructural: Project Cost 1/ Total Cost	Nonstructural: Project Cost 1/ Average Annual 2/	Nonstructural: Project Benefits Average Annual	"Mixed Alternative": Flood Damage with Project 100-Year Flood	Mixed: Flood Damage with Project Average Annual	Mixed: Project Cost 1/ Total Cost	Mixed: Project Cost 1/ Average Annual 2/	Mixed: Project Benefits Average Annual
OE-10	318,600	7,600	293,300	7,000	169,000	11,600	600	286,600	6,900	54,400	4,600	700	284,100	6,800	193,200	12,300	800
OE-12	2,754,000	137,000	438,000	21,900	3,445,000	225,100	115,100	No reasonably feasible nonstructural alternative					No reasonably feasible mixed alternative				
OE-13	300,000	15,000	No reasonably feasible structural alternative					287,300	14,400	6,400	500	600	No reasonably feasible mixed alternative				
OE-14	255,000	12,200	No reasonably feasible structural alternative					238,200	11,400	39,000	3,300	800	No reasonably feasible mixed alternative				
OE-15	517,900	20,000	267,900	10,400	430,800	29,700	9,600	477,800	18,500	204,400	17,200	1,500	224,200	8,700	635,200	47,000	11,300
OE-16	140,000	11,700	21,000	1,800	4,142,100	281,700	9,900	83,000	6,900	265,000	22,200	4,800	No reasonably feasible mixed alternative				
MI-2	1,350,000	25,800	No reasonably feasible structural alternative					1,282,800	24,500	164,600	13,800	1,300	No reasonably feasible mixed alternative				
WE-38	280,000	10,800	Approved PL-566 Project - Additional investigations now underway														
WE-39	10,746,800	644,800	9,629,000	577,700	607,200	41,800	67,100	6,376,500	382,600	676,400	56,700	262,200	5,258,700	315,500	1,283,600	98,500	329,300
WE-40	1,885,300	84,500	Approved PL-566 Project - Detailed investigations now underway														
WE-42	3,816,900	229,000	2,293,300	137,600	311,400	21,500	91,400	1,486,300	89,200	662,800	55,600	139,800	451,300	27,100	805,300	65,400	201,900
WE-43	172,500	9,900	No reasonably feasible structural alternative					27,600	1,600	148,800	12,500	8,300	No reasonably feasible mixed alternative				
WE-46	418,600	30,900	No reasonably feasible structural alternative					104,000	11,200	347,000	29,100	19,700	No reasonably feasible mixed alternative				
FA-55	390,000	23,400	Approved PL-566 Project - Construction underway														
CV-19	124,000	6,500	12,400	600	4,684,600	322,700	5,900	81,900	4,300	38,200	3,200	2,200	No reasonably feasible mixed alternative				
CV-22	622,600	48,100	Under detailed study by U.S. Army Corps of Engineers														
CV-23	1,244,200	149,300	Approved PL-566 Project - Classified as inactive due to lack of local funding														
CV-24	79,000	17,600	No reasonably feasible structural alternative					No reasonably feasible nonstructural alternative					No reasonably feasible mixed alternative				
CP-28	200,000	12,000	No reasonably feasible structural alternative					40,000	2,400	5,600	500	9,600	No reasonably feasible mixed alternative				
CP-30	277,000	16,600	22,200	1,300	1,147,400	79,000	15,300	53,600	3,200	56,300	4,700	13,400	No reasonably feasible mixed alternative				
CP-32	330,300	54,500	Approved PL-566 Project - Detailed investigations now underway														
CP-33	157,600	9,500	No reasonably feasible structural alternative					38,200	2,300	113,600	9,600	7,200	No reasonably feasible mixed alternative				
CP-35	172,500	10,400	No reasonably feasible structural alternative					17,300	1,000	55,200	4,600	9,400	No reasonably feasible mixed alternative				

1/ Price Base 1976.
2/ Amortized at 6 3/8 percent for 100 years.

A third plan included the same structural measures, but was combined with floodproofing. Land treatment, floodwater retarding structures, and dikes and floodwalls were used to reduce and control flood flows to manageable levels. Floodproofing measures were then utilized to reduce damage remaining from the reduced flows.

A large part of the damageable property in the region is not suited to economical floodproofing. Much of the road and bridge damage can only be reduced by reducing floodflows or enlarging the bridge. In other instances, floodproofing can create a potentially dangerous situation by giving residents a false sense of security. Residents may choose to remain in their floodproofed homes, when the more prudent action may be to evacuate to higher ground.

By utilizing floodproofing, in combination with structural measurements, it is often possible to reduce the cost and scope of a structural program while increasing the degree of protection afforded to the area.

Detailed investigations and analyses would be required to establish the most acceptable and effective combination of measures to reduce flood damages in the region. The three combinations considered in this study illustrate a range of possiblities. Final selection of a plan would require significant local inputs, consideration of environmental impacts, and a cooperative effort by local, state, and federal agencies.

8.4 SEDIMENT AND EROSION ALTERNATIVES

8.4A Construction Areas

Provisions should be made for the retention of optimum amounts of vegetative cover for watershed protection on all areas undergoing residential, highway, and industrial development and construction. Developers should prepare and follow plans designed to minimize the disruption of the hydrologic balance and the resulting erosion by maintenance of vegetative cover during construction. Contractors should utilize the natural landscape in their planning for environmental purposes. Where needed, developers and contractors should apply erosion control measures, such as temporary debris basins or desilting basins, seed and mulch exposed areas, create temporary diversions, and retain forest buffer zones during construction. Adequate planning prior to construction and close supervision of construction activities are needed to control erosion.

Naturally, some developers are reluctant to utilize erosion control measures, unless they can see some financial, aesthetic, or other tangible results. Consequently, sediment and erosion control ordinances and bylaws are needed to ensure compliance with good conservation practices during construction. These ordinances could be additions to present zoning, subdivision regulations, and/or building regulations.

8.4B Streambank Erosion

Some of the streambank erosion in the region is aggravated by development or activity which occurs too close to the streambank, destroying vegetation and mechanically moving bank material into the stream. In order to protect streams from this erosion pollution danger, we recommend the establishment and maintenance of stream buffer zones within 50 feet of the rivers and streams of the region. These zones should be maintained in forest or other permanent vegetative cover. In many cases, this buffer strip will not completely stabilize the streambank and structural measures, such as rock riprap, may be necessary. Vegetative means, if not completely successful in stabilizing streambanks, will reduce the problem and are desirable for wildlife and aesthetic reasons.

8.4C Tilled Cropland

The Conservation Operations Program of the Soil Conservation Service can assist landowners in applying conservation measures to prevent erosion on cropland. This technical assistance is coordinated through the conservation district and, in many instances, landowners can obtain cost sharing for installation of practices from the Agricultural Stabilization and Conservation Service.

Fiscal and personnel limitations make it necessary to establish priorities for technical and financial assistance. Priorities for technical assistance are provided by the conservation district board of supervisors in each county. Financial cost sharing program priorities are established by the Agricultural Stabilization and Conservation County Committee.

Since the installation of conservation practices is a purely voluntary effort on the part of landowners, priorities for providing technical assistance have tended to favor those farm operators who exhibit the most initiative and desire to install practices. The majority of technical assistance work is precipitated by landowner requests. This procedure has resulted in a good deal of assistance being provided to operators who are already highly motivated to install practices and who are aware of the benefits to be obtained from soil conservation efforts.

As a result of priority procedures and limitations on personnel and funding, many of the farms with severe erosion problems have not received much encouragement to install practices to alleviate the situation. However, these are the very operators who require the most encouragement, assistance, and continued follow-up, if they are to reduce erosion losses.

Cost sharing for conservation practices has favored production-oriented measures rather than erosion control practices. Naturally, the practices which are aimed toward increased production and increased farm income are popular with farmer-recipients. Erosion control practices which may result in a decrease in production tend to be less popular, though no less necessary.

If erosion losses on tilled cropland are to be reduced to acceptable levels, more emphasis will need to be placed on locating, contacting, encouraging, and assisting the farmers with the most severe problems. Since it appears unlikely that significant increases in funding or personnel levels will be forthcoming, other technical assistance and cost sharing measures will need to receive reduced emphasis.

A first step in reducing cropland erosion losses could involve a detailed cropland inventory to assess erosion losses and determine needed treatment for each farm in the conservation district. Priorities for assistance could then be established. SCS technicians should have definite annual goals to contact and assist high priority farm owners. Cost sharing assistance for erosion control practices on priority farms should be allocated the maximum possible funding, even if this acts to the detriment of some of the more popular production-oriented measures presently cost shared.

8.5 WETLANDS

In order to reduce projected wetland losses and to provide additional protection to inland wetland areas, this study has developed a hierarchy of protective measures to be pursued. The hierarchy is based on the degree of protection provided to the wetlands against unwise development. The basic preference list is, as follows:

1. Public and Quasi-public Ownership;

2. Restrictions under Massachusetts General Laws, Chapter 131, Section 40A, the Inland Wetlands Restriction Act;

3. Conservancy Zoning;

4. Protection under Massachusetts General Laws, Chapter 131, Section 40, the Wetlands Protection Act.

This list of options was then employed to assist in the development of alternatives for additional wetlands protection.

8.5A Public Acquisition

Accelerated acquisition of inland wetlands by state, county, city, and town agencies could be implemented to add to the projected acquisition of 6,000 acres. State agency acquisition of wetlands will continue to utilize existing funds, such as the Inland Fish and Game Fund. In order to accelerate acquisition, particularly the wetlands for wildlife program of the Massachusetts Division of Fisheries and Wildlife, additional funding from the Massachusetts legislature will be needed.

The Massachusetts Self-Help program should be funded on a regular basis. The Heritage Conservation and Recreation Service's Land and Water Conservation Fund financing has been increased. A portion of the Self-Help funds and some of the Massachusetts share of the Land and Water Acquisition Fund should be earmarked for wetlands acquisition.

Projections indicate that about 6,000 acres of wetlands will be acquired by 1990 through existing programs. A reasonable goal for additional acquisition is 6,000 acres for a total of 12,000 acres by 1990.

Priority for wetlands acquisition should go to the larger wetlands of the regions. These larger areas offer more potential for wildlife habitat than a like acreage of smaller units. Management of a large area is also likely to be easier than management of several smaller areas. In addition, the large areas offer the potential for lower per-acre acquisition costs as the interior portions of the areas are likely to be without road access and be less valuable real estate.

The 99 wetlands evaluated by the Soil Conservation Service and further described in Chapter 5 are among the largest wetlands in the region. Those with the highest ratings are shown in Table 8.3. These highest rated wetlands should be considered for early public acquisition.

TABLE 8.3 WETLANDS WITH THE HIGHEST RATINGS

	Wetland	Size (acre)	Approximate percentage Publicly or Quasi-Publicly Owned
CP-12	Quaboag River Wetland Brookfield & West Brookfield	1,082	30
MI-18	Lake Rohunta Wetland Athol, New Salem	730	5
MI-9	Doe Valley Swamp, Athol	281	0
CP-14	Allen Swamp, East Brookfield	230	0
MI-10	Otter River Wetland Gardner, Hubbardston, Templeton	370	0
CV-6	Leverett Pond Wetland, Leverett	92	0
CV-1	Keyes Swamp, Conway	51	0
CV-3	Great Pond Wetland, Hatfield	213	0
CV-4	Lake Warner Wetland, Hadley	84	0
CV-10	Lawrence Swamp, Amherst, Belchertown	773	25
CP-8	Eames Pond Wetland, Paxton	250	15
CP-13	Perry Pond Wetland, North Brookfield & East Brookfield	145	0
SC-2	Harts Pond Swamp, Agawam and Southwick	130	0

8.5B Inland Wetlands Restriction Act

Progress in implementing the Restrictions Act has been agonizingly slow. Problems have resulted from the low staffing levels and the complexity of the project. Identification and location of wetland areas have been proceeding at an acceptable rate. The time-consuming procedures involve: transfer of wetlands data to assessor's maps, determination of wetland tract ownership, and preparation of legal descriptions of each piece of wetland slated for restriction. A significant increase in staff and funding for the Restriction Program is needed if more rapid results are to be obtained.

8.5C Protective Zoning

Conservancy zones can be a useful tool for the protection of wetlands. Flood plain zones, wetland zones, and conservancy zones usually place significant restrictions against development. Over 8,000 acres of inland wetlands are now in some form of protective conservancy zoning. In some instances, only the major wetlands in a town have been included in the conservancy zone.

Communities are encouraged to establish conservancy zones to protect their inland wetlands. Such zoning should be comprehensive and include, as a minimum, all identified wetland areas above 5 acres in size. Communities with partial zoning of wetland areas are encouraged to expand coverage to include all wetland areas of significant size.

8.6 WATER SUPPLY ALTERNATIVES

Appendix A of this report identifies sites which have potential for municipal water supply reservoirs. Topography of the potential storage basin, geology of the abutments and foundation, and land rights costs appear to be favorable.

Information in Appendix A was abstracted from the Inventories of Potential and Existing Upstream Reservoir Sites prepared by the Soil Conservation Service in cooperation with the Massachusetts Water Resources Commission. Data is based on reconnaissance level investigations, and much more detailed investigations are needed before any of the sites could be selected for development for municipal water supply storage.

Communities in need of water supply are encouraged to study the possibilities offered by these potential reservoir sites and to take the necessary acquisition or zoning steps to protect suitable sites from development.

The Water Resources Commission can acquire water impoundment sites to meet the future water resources needs of the Commonwealth as authorized by Chapter 767 of the Acts of 1970, Massachusetts General Laws.

8.7 WATER QUALITY ALTERNATIVES

Nonpoint pollution sources need to be evaluated to determine their magnitude and effects on water quality. Results of the limited Section "208" water quality studies being conducted by regional planning agencies in the nondesignated portions of the region should indicate the critical problem areas. As previously stated, only two towns of the region are within areas designated for water quality management planning under the "208" program.

Local communities should place more emphasis on soils limitations when planning for growth. Detailed soil surveys made in region towns indicate significant areas with severe limitations for septic tank systems. Communities adopting or updating local zoning ordinances need detailed soils information to intelligently guide growth to suitable areas. In some cases, the use of large residential lot size in certain soils can minimize septic tank-leach field problems, which might develop if smaller lot size and greater density of development were permitted. Conversely, smaller lot sizes may require sewage collection systems because of inadequate soils for onsite disposal.

On the basis of projected population increases and the lack of complete municipal sewerage, the following communities should obtain detailed soil surveys from the SCS to aid in guiding growth:

Ashburnham	East Brookfield	Templeton	Westhampton
Athol	Granville	Ware	

8.8 RECREATION

To meet 1990 recreational needs (NED), the following alternatives are presented:

1. Install the West Branch of the Westfield River Watershed Project (PL 83-566) to provide:

   2,000 front feet of beach
   327 campsites
   214 picnic tables
   26 miles of hiking trail

2. Camping--Provide additional campsites at state parks and forests with existing camping facilities. Tolland - Otis State Forest (SF), Savoy Mountain - Florida SF, Mohawk Trail SF, D.A.R. SF, Erving SF, Otter River SF.

3. Picnicking--Supply an additional 2,200 picnic tables or approximately 20 percent of the estimated 1990 need. These tables could be located in state forests and parks, and on town recreation and conservation lands.

4. Swimming--Develop new and/or additional swimming beaches at Erving State Forest; and in the cities of Springfield and Chicopee.

5. Hiking--Completion of two connector trails will add 65-70 miles of long distance trail to the Massachusetts Commonwealth Trail System. The Deerfield River Trail, 40 miles, is now under construction. This trail is approximately half of the proposed Northwestern Massachusetts Connector Trail. Similarly, the Westfield River Trail, 25 miles, now under construction is proposed as an east-west connector trail.

To meet 1990 recreation needs (EQ), the following alternatives are presented:

6. Promote acquisition of the additional natural areas as identified in the 1974 Massachusetts Landscape and Natural Areas Survey. It is anticipated that 60 of the 100 natural areas will be adequately protected by 1990 under ongoing programs.

7. Implement the Massachusetts Scenic and Recreational Rivers Act within the region.

8. Institute a coordinated greenway program for the Connecticut River and major tributaries such as the Deerfield, Millers, Westfield and Chicopee which emphasizes streambank acquisition. This work should be coordinated with the flood plain management program recommended in <u>The River's Reach</u>, a Plan for Flood Damage Reduction and Flood Plain Management in the Connecticut River Basin, New England River Basins Commission.

8.9 COMPARISON OF ALTERNATIVES AND NEEDS

Alternatives and needs were compared for each study concern by national objective. This information is summarized and displayed in Table 8.4.

TABLE 8.4 COMPARISON OF ALTERNATIVES AND NEEDS

National Objective	Study Concern		Alternatives	Comparison with Needs
NED	Land Use Agricultural Land	1-1	Ignore situation and continue to let market forces operate to the demise of the agricultural sector.	1. Would not generate any positive solution to expressed needs.
		1-2	Undertake a multi-faceted program whereby state and local officials, public and private institutions would actively press for public programs to preserve agricultural land by keeping land in agricultural production.	1. Would directly and indirectly have a positive impact on meeting the expressed need of maintaining or increasing the agricultural base.
			a. Identify sources of comparative disadvantages and develop public policies and programs to minimize the disadvantages wherever possible.	a. Would increase economic viability and thereby contribute to reversing the trend of agricultural land loss.
			b. Complete soil surveys to determine most feasible locations of future developments while prohibiting their location on productive agricultural lands.	b. Would minimize adverse impacts of development upon agriculture and would contribute to EQ needs as well.
			c. Form task force to determine negative impacts of presently enacted and future legislation upon the agriculture sector and revise such legislation to minimize adverse impacts.	c. Would potentially help to minimize the impact of some ordinances (e.g., zoning ordinances) that promulgate specific goals but create incentives which are in opposition to those goals.
			d. Form task force to actively seek public programs to provide incentives for food and fiber processing and marketing firms to locate in the region.	d. Same as a. above.
			e. Form research task force to develop or locate new crops, crop and livestock products, which could be produced in the region and thereby increase diversity of production.	e. Same as a. above.
NED & EQ	Land Use Forest Land	1-3	Increase management of public and private forest land by increasing personnel working on state land, personnel providing technical assistance to private landowners, and by employing professional consulting foresters.	1. Will meet about 23 percent of the 1990 needs for wood products. 2. Increase the acres managed by about 40 percent. 3. Adequately meets the need for technical assistance on forest management.

TABLE 8.4 - cont. COMPARISON OF ALTERNATIVES AND NEEDS

National Objective	Study Concern	Alternatives	Comparison with Needs
NED	Land Use Forest land	1-4 Increase incentives to landowners to encourage them to utilize and manage their forest land for timber.	1. Will meet about 24 percent of the 1990 needs for wood products. 2. Increase the acres presently managed by about 41 percent. 3. Will meet the need for increased incentives in the area.
		1-5 Establish a program to develop diversified markets for forest products.	1. Will meet about 25 percent of the 1990 needs for wood products. 2. Increase the acres presently managed by about 42 percent. 3. Over a period of time this program will meet nearly all the needs for diversified markets.
NED & EQ	Land Use Forest land	1-6 Establish an information and education program to inform private landowners about the benefits of forest land management.	1. Will meet about 7 percent of the 1990 needs for wood products. 2. Increase the acres presently managed by about 12 percent. 3. Adequately meet the needs for knowledge on forest land management. 4. Adequately meets the need for knowledge on urban forest land management.
NED	Flooding	2-1 Nonparticipating cities and towns participate in the HUD Flood Insurance Program.	1. Limits future development of flood-prone areas and encourages communities to consider flood hazards when planning growth.
		2-2 Implement structural measures to reduce flood damage in the following subwatersheds: WE-39, WE-42.	1. Reduces average annual flood damage from \$873,800 to \$715,300.
		2-3 Implement floodproofing measures to reduce flood damage in the following subwatersheds: DE-13, WE-39, WE-42, CP-28, CP-30, CP-35.	1. Reduces average annual flood damage from \$927,800 to \$492,800.

TABLE 8.4 - cont. COMPARISON OF ALTERNATIVES AND NEEDS

National Objective	Study Concern		Alternatives	Comparison with Needs
NED	Flooding cont.	2-4	Implement a combination of structural and flood-proofing measures to reduce flood damage in the following subwatersheds: WE-39, WE-42.	1. Reduces average annual flood damage from $873,800 to $342,600.
EQ	Erosion & Sediment	3-1	Establish erosion and sediment control ordinances in municipalities with the most potential for urban development.	1. Reduces erosion on the 4,400-acres per year undergoing urbanizing development.
NED	Erosion & Sediment	3-2	Establish program by SCS aimed at eliminating high erosion losses on "problem" farms of region. Inventory conservation measures and follow-up procedure.	1. Reduces high soil losses on 6,000 acres, 20 percent of tilled cropland.
EQ	Erosion & Sediment	3-3	Establish and maintain stream buffer zones with forest and other permanent vegetative cover, within 50 feet of the region's rivers and streams.	1. Reduces erosion from the area with the greatest potential for stream degradation through sedimentation.
EQ & NED	Wetlands	4-1	Accelerate wetlands acquisition programs to acquire an additional 6,000 acres of regionally important wetlands.	1. Reduces projected wetland loss. 2. Provides public access to inland wetlands for passive recreation.
EQ	Wetlands	4-2	Accelerate the Inland Wetlands Restriction Program.	1. Reduces projected wetland losses.
EQ & NED	Wetlands	4-3	Expand conservancy zoning or other special zoning regulations for wetland areas.	1. Reduces projected wetland losses. 2. Provides additional protection to the 46,900 acres of inland wetlands which are not protected by public ownership, or the Inland Wetland Restriction Act.
NED	Water Supply	5-1	Communities investigate water supply opportunities offered by the 158 reservoir sites identified in Appendix A.	1. Identified reservoir sites have potential to supply about 400 million gallons per day of safe yield.

TABLE 8.4 - cont. COMPARISON OF ALTERNATIVES AND NEEDS

National Objective	Study Concern		Alternatives	Comparison with Needs
NED	Water Supply cont.	5-2	Potential reservoir sites which can meet community water supply needs are acquired or otherwise protected from development which would make them unavailable or prohibitively expensive when needed as water supplies.	1. Reservoirs which have potential to meet a specific community need for water supply will be available when needed.
EQ	Water Quality	6-1	Obtain detailed soil surveys and use them to guide growth in the following communities: Ashburnham, East Brookfield, Templeton, Athol, Granville, Ware, Westhampton	1. Reduces the potential harmful effects on water quality caused by malfunctioning septic tank systems located in unsuitable soils. 2. Has benefits in the area of land use by directing development away from "sensitive areas." 3. Has benefits in land use (agricultural land) by identifying prime agricultural land and land of state and local importance for farming.
NED	Recreation	7-1	Provide 500 additional campsites within region.	1. Supplies about 35 percent of 1990 needs.
		7-2	Provide an additional 2,200 picnic tables.	1. Supplies approximately 20 percent of 1990 needs.
		7-3	Provide 70 miles of hiking trails along major river corridors.	1. Supplies approximately 9 percent of 1990 needs.
EQ	Recreation	7-4	Acquire an additional 40 natural areas as identified in the 1978 Massachusetts Landscape and Natural Area Survey.	1. Will help maintain region's supply of natural areas.
		7-5	Implement Massachusetts Scenic and Recreational Rivers Act in region.	1. Will help maintain riverine resources.
		7-6	Provide 4,500 feet of beach front.	1. Supplies about 46 percent of 1990 needs.
NED & EQ	Recreation	7-7	Institute greenway program for Connecticut River and major tributaries.	1. Provides passive recreation opportunities. 2. Increases public awareness of environmental resources.

8.10 ALTERNATIVE ACCOUNTS DISPLAY

The Water Resources Council's Principles and Standards for Planning of Water and Related Land Resources require that a system of information accounts be established to display beneficial and adverse effects of each alternative proposed to meet an objective. The effects of each alternative on national economic development, environmental quality, regional development and social well-being are indicated to provide a basis for comparing alternatives. The purpose is to display beneficial and adverse effects so that different levels of achievement of each objective and trade offs between alternatives can be discerned and compared. These beneficial and adverse effects are displayed in Table 8.5.

8.11 POTENTIAL ENVIRONMENTAL IMPACTS OF ALTERNATIVES

Each alternative was evaluated to determine what significant environmental impacts, if any, it would have on the region. These findings are displayed in Table 8.6.

TABLE 8.5 ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
<u>1-Land Use</u>	<u>Beneficial Effects</u>	<u>Beneficial Effects</u>	<u>Adverse Effects</u>	<u>Adverse Effects</u>
1-1 Agricultural Land - continue present land policies.	Minimizes public costs relative to preservation programs. <u>Adverse Effects</u> Projected loss of 16,501 to 102,908 acres and net income potential from lost production.1/ Pro-rated cost of administering zoning ordinances. Loss of tax revenue from agricultural-horticultural assessments.	Continuing loss of agricultural land will decrease amounts of herbicides, pesticides and fertilizer nutrient entering water resources through runoff. Less erosion and sedimentation resulting from less land being cultivated. <u>Adverse Effects</u> Less diversified land use mix, thus lowering the aesthetic quality of the region. Adverse impact upon wildlife feeding habitat through a decrease in boundary areas of open and forestland.	Adverse to the extent that loss of agricultural production results in loss of input and output agricultural service and marketing facilities.	Decrease in agricultural land decreases the aesthetic qualities of the area. Increase in food costs to extent of increased transportation charges for increased food imports.

1/ Approximate agricultural valuations (state averages) were computed by Dr. E. Engle, Department of Food and Resource Economics; University of Massachusetts (1974) for eight categories of agricultural land. Shade tobacco and nurseries: $480-720/acre; binder tobacco, vegetables, potatoes: $150-230/acre; cropland, pasture (tillable: $110-170/acre; orchards: $160-240/acre; cranberry bogs: $560-840/acre; untillable permanent pasture: $40-60/acre; farm woodland: $20-30/acre; nonproductive farm woodland: $5-7/acre.

TABLE 8.5 - cont.

ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
1-Land Use - cont.	Beneficial Effects	Beneficial Effects	Beneficial Effects	Beneficial Effects
1-2 Agricultural land - preserve or increase existing quantities of agricultural land.	Net earning and subsequent tax revenues that would be lost without preservation. Food cost savings to extent that decrease in food products would be imported from other areas, thus increasing food prices. Preservation would preclude the projected annual loss of agricultural production value (between 3,000,000 and 8,000,000, 1967 constant $).2/	Benefit would be derived to the extent that preservation of agricultural land would enhance the aesthetic qualities of diversified land use mix. Maintaining agricultural land would preserve boundary areas which would enhance wildlife habitat.	Benefits accrue to the extent that rates of unemployment and underemployment fall relative to such rates if land were not preserved. Much tourism due to aesthetic qualities which are enhanced through the maintenance of a diversified land use mix. Benefits accrue to the extent that agricultural land enhances the tourist industry.	Social well-being is enhanced to the extent that preservation measures enhance the aesthetic qualities of the region. To the extent that preservation measures result in lower food prices than would exist without a Preservation Program, SW-B is increased.
	Adverse Effects	Adverse Effects	Adverse Effects	Adverse Effects
	Costs of preservation measures more expensive than present policies.1/ A. Purchase lease-back program: Initial cost of purchase ($600-$3,000 per acre) minus revenues derived from renting to agricultural entrepreneurs. B. Development Rights Program: Cost of Purchasing Development Rights.	Increases pesticide, herbicide and other residues entering water areas through runoff has a detrimental impact on environmental quality. Increased erosion and sedimentation resulting from cultivating preserved acreage.	One potential adverse impact stems from the development that would occur on the preserved acreage without a preservation program and that which would not occur with a preservation program. Although there is enough developable land in the region, even with a Preservation Program, added costs of developing nonpreserved land may result in some firms locating elsewhere.	To extent society is adversely effected by noise and smells of agricultural production.

1/ Values of agricultural land in the region are dependent upon provision of roads, water, sewer, electricity and physical characteristics. A purchase lease-back program would involve a $600-$3,000 range. Prices that would be relevant for a Development Rights Program would be to determine an acceptable rate of return per acre and from that determining the capital cost of purchasing that land based on an acceptable return and subtracting the capital cost/acre from the market value of the land. This program is further complicated by the fact that, although almost all agricultural land is zoned residential, much land would not be developed due to location of flood plains, wetlands, and/or the physical characteristics of the land itself. Thus, under these circumstances, prices of development rights would be negligible.

2/ Value of lost production computed by multiplying average value of production per acre (expressed in constant 1967 dollars) times the projected range of agricultural acreage decline.

TABLE 8.5 - cont. ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
1-Land Use - cont.	Beneficial Effects	Beneficial Effects	Beneficial Effects	Beneficial Effects
1-3 Increase management of public and private forest land by increasing personnel working on state land and personnel providing technical assistance to private landowners, and by employing professional consulting foresters.	Sawtimber-3,179,400 c.f./yr. valued at $2,066,600 Pulpwood-193,600 c.f./yr. valued at $42,980 Recreation General-83,400 V.D./yr. 1/ valued at $166,800 Recreation Special-744,800 V.D./yr. valued at $372,400 Water-19,000 A.F. valued at $47,500 Adverse Effects Variable costs-$410,000/yr.	Increase in technical services for urban forest management. Improvement in wildlife habitat by creating a more diverse forest cover. Increased management and protection enhances the benefits provided by forest land. Increase in technical assistance insures the protection of the quality of soil, water and aesthetics. Adverse Effects Possible minor increase in erosion and sediment.	Increase employment by hiring 11 professionals, 4 technicians and 20 woods workers. Increase in cut provides additional wood for presently underutilized mill capacity; provides increase in income to loggers and mills from additional wood; provides increase in revenues from tourism. Increase in industry employment because of increase harvest. Increase in recreational employment because of increase in visitor days.	Increased employment from more state, industry and recreational employment.
1-4 Increase incentives to landowners to encourage them to utilize and manage their forest land for timber.	Beneficial Effects Sawtimber-1,305,800 c.f./yr. valued at $848,770 Pulpwood-2,100,800 c.f./yr. valued at $466,400 Recreation General-178,800 V.D./yr. valued at $357,600 Recreation Special-264,600 V.D./yr. valued at $1,323,000 Water-27,800 A.F./yr. valued at $69,500 Adverse Effects Variable Costs-$116,600/yr.	Beneficial Effects Increase in forest management promotes and enhances benefits derived from forest land for now and in the future. More forest land managed decreases loss to urban development.	Beneficial Effects Increases in regional income due to increase timber harvesting and recreation V.D. Enhances future employment because of increased forest productivity.	Beneficial Effects Increases the present and future employment.

1/ V.D. = Visitor Days.

TABLE 8.5 - cont. ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
1-Land Use - cont. 1-5 Establish a program to develop diversified market for forest products.	Beneficial Effects Sawtimber-1,929,600 c.f./yr. valued at $1,252,280 Pulpwood-4,615,300 c.f./yr valued at $358,600 Recreation Special-6,700 V.D./yr valued at $33,500 Water-15,700 A.F. valued at $39,250 Adverse Effects Variable Costs-$536,000/yr. Implementation Costs-$10,000,000	Beneficial Effects Increase in utilization promotes increase in wildlife habitat and provides better forest management practices. Provide market for forest products from land clearing, decreases burning and land fills. Adverse Effects Increases in erosion and sediment minimal.	Beneficial Effects Increase in employment dependent upon plant size. Addition of two professionals to state employment. Adverse Effects Implementation cost of $10,000,000 by private industry. Annual operating cost of $500,000	Beneficial Effects Increased employment from industry and state. Increased recreation close to urban centers.
1-6 Establish an information and education program to inform private landowners about the benefits of forest land management.	Beneficial Effects Sawtimber-809,900 c.f./yr. valued at $526,400 Pulpwood-156,200 c.f./yr. valued at $34,700 Recreation General-171,200 V.D./yr. valued at $342,400 Recreation Special-107,500 V.D./yr valued at $537,500. Adverse Effects Variable Cost-$54,000/yr.	Beneficial Effects Provide information to urban forest landowners on management opportunities. Urban forestry technical assistance will help make development of forest land more environmental and aesthetically sound.	Beneficial Effects Increase income to area by increasing visitor days, valued at $449,900 Increased income from an increase in employment from more recreation and timber harvesting.	Beneficial Effects More aesthetic urban environment. Increased employment. Increase in recreational opportunities close to urban centers.

TABLE 8.5 - cont. ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
2-Flooding 2-1 Nonparticipating cities and towns participate in the HUD Flood Insurance Program. Joining the program entails establishing effective flood plain restrictions; such as, zoning, subdivision controls and building regulations for development within the flood plains.	Beneficial Effects Prevents increases in damageable properties. Adverse Effects $625,000 initial cost of program. $25,000 per year for operation and management of program.	Beneficial or Adverse Effects Renewable resource lands (flood plains) protected as a result of required land use regulations. Tends to maintain existing water quality by preventing building development close to streams. Maintenance of streamsite habitats minimizes hazards to endangered species of animals, fish and plants.	Beneficial Effects Prevents increases in damageable properties. Prices of buildable land may go up, thus increasing property values. Adverse Effects Flood plain land no longer available for residential, commercial or industrial use. Prices of buildable land may go up which may adversely effect industrial and commercial activity. $12,500 per year for regional operation and management costs of program.	Beneficial or Adverse Effects Psychological satisfaction from the action. Program will help maintain present neighborhood character in vicinity of flood hazard areas. Remaining uplands will be subject to accelerated neighborhood change. Present landowners may face loss of property value due to program. Provides an equitable distribution of flood hazard risks.
2-2 Implement structural measures. A program of structural measures is economically feasible in the following subwatersheds: WE-39, WE-42.	Beneficial Effects Average annual flood damage will be reduced by $158,500. Adverse Effects Average annual cost is estimated to be $63,300. 1/	Beneficial or Adverse Effects Irreversible commitment of land for program measures. Streams altered for project measures.	Beneficial Effects Developed land no longer subject to flooding from 100-year storm. Average annual damage will be reduced by $158,500. Creates 18 man years semi-skilled employment. Adverse Effects Local average annual cost is estimated to be $7,100.	Beneficial or Adverse Effects Reduce health and safety hazards associated with flooding. Psychological satisfaction from the action. Some landowners may be adverse to the action. Creates 18 man years semi-skilled employment.

1/ Discount estimated evaluation period.

TABLE 8.5 - cont. ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
2-Flooding - cont. 2-3 Implement floodproofing measures. A program of floodproofing existing structures is economically feasible in the following subwatersheds: DE-13, WE-39, WE-42, CP-28, CP-30, CP-35.	Beneficial Effects Average annual flood damage will be reduced by $435,000. Adverse Effects Average annual cost is estimated to be $122,600.	Beneficial or Adverse Effects May adversely effect appearance of some existing structures.	Beneficial Effects Average annual damage will be reduced by $435,000. Will create 37 man years semi-skilled employment. Adverse Effects Local average annual cost is estimated to be $110,300.	Beneficial or Adverse Effects Reduces health and safety hazards associated with flooding. Psychological satisfaction from the action. Some landowners may be adverse to the action. Will create 37 man years semi-skilled employment.
2-4 Implement both structural measures and flood proofing. A program combining structural measures with floodproofing is economically feasible in the following subwatersheds: WE-39, WE-42.	Beneficial Effects Average annual damage will be reduced by $531,200. Adverse Effects Average annual cost is estimated to be $163,900.	Beneficial or Adverse Effects Irreversible or irretrievable commitment of land for program measures. Stream channel altered for project measures. May adversely effect the appearance of some existing structures.	Beneficial Effects Average annual damage will be reduced by $531,200. Developed land no longer subject to flooding from 100-year storm. Will create 52 man year semi-skilled labor. Adverse Effects Local average annual cost is estimated to be $114,700.	Beneficial or Adverse Effects Psychological satisfaction from the action. Some landowners may be adverse to the action. Will create 52 man years semi-skilled labor. Reduces health and safety hazards associated with flooding.
3-Erosion & Sediment 3-1 Establish erosion and sediment control ordinances in municipalities with the most potential for urban development.	Beneficial Effects 13,000 tons/yr. sediment damage reduction. Adverse Effects $40,000 initial capital cost to initiate program. One and one-half man years to manage program.	Beneficial or Adverse Effects Reduce erosion on 4,400 acres/year of construction sites. Eliminate 13,000 tons/yr. of construction site produced sediment. Improvement of water quality downstream.	Beneficial Effects Adverse Effects	Beneficial or Adverse Effects Will increase cost of developing land for urban purposes.

TABLE 8.5 - cont.

ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
3-Erosion & Sediment - cont.				
3-2 Establish program by SCS aimed at eliminating high erosion losses on "problem" farms of region. Inventory, conservation measures and follow up procedure.	Beneficial Effects Productivity of farmland is maintained. $58,000 per year sediment damage reduction. Adverse Effects $48,000/yr. cost of program.	Beneficial or Adverse Effects Reduce erosion on 6,000 acres of tilled cropland. Eliminate 9,600 tons/year of sediment from these sources. Improve stream water quality.	Beneficial Effects Reduce average annual sediment damages by $58,000. Adverse Effects	Beneficial or Adverse Effects Create two professional jobs per year. Psychological satisfaction from the action.
3-3 Establish and maintain stream buffer zones, forest and other permanent vegetative cover within 50 feet of the region's rivers and streams.	Beneficial Effects Action results in slowing down of streambank erosion and subsequent sedimentation. Adverse Effects Annual administration cost of program is estimated to be $5,000. Loss of production on agricultural land.	Beneficial or Adverse Effects Reduce erosion and thereby reduce subsequent sedimentation. Maintain permanent vegetation along 550 miles of rivers and streams. Improve stream water quality. Improve quality of fish and wildlife habitat.	Beneficial Effects May increase the supply of recreation activity days in the region. Adverse Effects	Beneficial or Adverse Effects Some landowners may be dissatisfied with reduction in cropland acreage. Psychological satisfaction from the action.
4-Wetlands 4-1 An accelerated acquisition program to acquire an additional 6,000 acres (6,000 acres are expected to be acquired under ongoing programs) of regionally important wetlands.	Beneficial Effects Will contribute to meeting recreational and educational needs. Tends to maintain recreational quality of 6,000 acres. Adverse Effects Average annual cost is estimated to be $252,000.	Beneficial or Adverse Effects Will tend to preserve existing wildlife habitat. May preserve environmentally unique and valuable areas. Irreversible commitment of 6,000 acres prevented. Tends to maintain existing water quality. Tends to maintain low flow regime.	Beneficial Effects Will contribute to meeting recreational and educational needs of region. Adverse Effects Average annual cost is estimated to be $252,000. Prices of buildable land may increase and adversely effect economic activity. Decrease property tax base. Initial capital cost is estimated to be $4,200,000.	Beneficial or Adverse Effects Psychological satisfaction from the action. Some resource owners may be adverse to the action.

TABLE 8.5 - cont.

ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
<u>4-Wetlands</u> - cont. 4-2 Accelerate Inland Wetland Restriction Program.	<u>Beneficial Effects</u> Will contribute to meeting recreational needs. <u>Adverse Effects</u> Annual cost is estimated to be $250,000.	<u>Beneficial or Adverse Effects</u> May lead to preservation of environmentally unique and valuable areas. Will tend to preserve existing wildlife habitat. Tends to maintain existing water quality.	<u>Beneficial Effects</u> <u>Adverse Effects</u> Annual cost is estimated to be $250,000.	<u>Beneficial or Adverse Effects</u> Psychological satisfaction from the action. Some resource owners may be adverse to the action.
4-3 Expand special regulations for wetland areas such as, Conservancy Zoning.	<u>Beneficial Effects</u> Discourages improper land use of wetlands.	<u>Beneficial or Adverse Effects</u> Will tend to preserve existing wildlife habitat. May preserve environmentally unique and valuable areas. Tends to maintain existing water quality. Tends to maintain low flow regime.	<u>Beneficial Effects</u> <u>Adverse Effects</u> Initial capital cost is estimated to be $50,000. Prices of buildable land may increase and adversely effect economic activity. Decrease property tax base.	<u>Beneficial or Adverse Effects</u> Psychological satisfaction from the action. Some resource owners may be adverse to the action.
<u>5-Water Supply</u> 5-1 Investigate potential surface water reservoir sites for use as municipal water supplies.	<u>Beneficial Effects</u> <u>Adverse Effects</u> Cost of investigations.	<u>Beneficial or Adverse Effects</u>	<u>Beneficial Effects</u> More fully evaluates the potential of these reservoir sites.	<u>Beneficial or Adverse Effects</u> Provides community with sound data upon which to base future planning.
5-2 Acquire or otherwise protect suitable potential surface water reservoir sites.	<u>Beneficial Effects</u> Potential reservoir site is available when needed to provide water for economic growth. <u>Adverse Effects</u> Cost of land purchase or easements.	<u>Beneficial or Adverse Effects</u> Present land use is maintained. Future land use may change to open water.	<u>Beneficial Effects</u> Potential reservoir site is available when needed to provide for regional economic growth.	<u>Beneficial or Adverse Effects</u> Assures water supply for future needs.

TABLE 8.5 - cont. ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development.	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
<u>6-Water Quality</u> 6-1 Obtain detailed soil surveys and use them to aid in guiding growth in the following communities: Ashburnham, Athol, E. Brookfield, Granville, Templeton, Ware, Westhampton	<u>Beneficial Effects</u> Assists in determining least cost alternatives to solving water quality problems. <u>Adverse Effects</u> Initial cost is estimated to be $100,000.	<u>Beneficial or Adverse Effects</u> Provides tool for maintaining present quality of all water and related land resources.	<u>Beneficial Effects</u> Will create 4 man years employment for a professional soil scientist. <u>Adverse Effects</u> Initial cost to towns within the region is estimated to be $80,000.	<u>Beneficial or Adverse Effects</u> Psychological satisfaction from the action. Provides basis for determining public health problems associated with water quality.
<u>7-Recreation</u> 7-1 Provide 500 additional campsites within the region.	<u>Beneficial Effects</u> Will provide an additional 115,000 activity days or $230,000 in recreation benefits annually. <u>Adverse Effects</u> Average annual cost including O, M & R of about $175,000. Loss of potential timber harvest on 65 acres of woodland.	<u>Beneficial or Adverse Effects</u> Provides opportunity to modify landscape quality. Creation of 65 acres of camping facilities. Modify 65 acres of forest land by clearing openings for tent sites access and other facilities. May reduce quality of wildlife habitat on approximately 65 acres.	<u>Beneficial Effects</u> Will create 4 permanent semi-skilled jobs. Will create 7 semi-skilled jobs for 1 year. Will create approximately 47,000 activity days or $94,000 in recreation benefits annually to those within the region. May attract recreation oriented firms. <u>Adverse Effects</u> Loss of potential timber harvest on 65 acres of woodland.	<u>Beneficial or Adverse Effects</u> Will provide 115,000 activity days for recreational opportunities. Will create 4 permanent semi-skilled jobs. Will create 7 semi-skilled jobs for 1 year. Provides for a more equitable distribution of recreational resources. Will create seasonal population influx. Psychological satisfaction from the action.

TABLE 8.5 - cont. ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
7-Recreation - cont.	Beneficial Effects	Beneficial or Adverse Effects	Beneficial Effects	Beneficial or Adverse Effects
7-2 Provide an additional 2,200 picnic tables.	Provides an additional 210,000 activity days or about $420,000 in recreation benefits annually. Adverse Effects Average annual cost including O, M & R of about $208,000.	Provides opportunity to maintain or increase landscape quality. Creation of 75 acres of picnic facilities. Modifies 75 acres of forest land by clearing for picnic sites. May reduce quality of wildlife habitat on approximately 75 acres.	Will create 1 permanent semi-skilled job. Will create approximately 86,000 activity days or about $172,000 in recreation benefits annually to those within the region. May attract recreation oriented firms. Adverse Effects Loss of potential timber harvest on 75 acres of woodland.	Will provide 210,000 activity days for recreational opportunities. Will create 3 permanent semi-skilled jobs. Provides for more equitable distribution of recreation resources. Will create seasonal population influx. Psychological satisfaction from the action.
7-3 Provide hiking trails within proposed greenbelts. Approximately 70 miles of trail.	Beneficial Effects Provide passive recreation opportunities. Adverse Effects Costs $350,000.	Beneficial or Adverse Effects Increases management of natural and developed areas for human enjoyment.	Beneficial Effects	Beneficial or Adverse Effects Psychological satisfaction from the action. Some landowners may be adverse to the action.
7-4 Acquire 12 natural areas (as identified by Natural Area Survey) by quasi-public or public agency.	Beneficial Effects Preservation of unique natural areas will help maintain attractiveness of region for tourists and other recreation users. Adverse Effects Annual operation budget for program of $20,000. Costs involved in implementing program.	Beneficial or Adverse Effects Preservation of unique natural areas would be monitored by region residents. This will contribute to preservation of those areas not considered "safe indefinitely."	Beneficial Effects Creates 10 skilled temporary part-time jobs. Economic value to the region of each area would be identified. Maintain attraction of area for tourists and other recreation use. Adverse Effects Recommendations made may preclude commercial, industrial, or residential development in certain areas.	Beneficial or Adverse Effects Action would increase public awareness. Psychological satisfaction from the action. Landowners may be adverse to some recommendations. Create 10 skilled temporary part-time jobs.

TABLE 8.5 - cont.

ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
7-Recreation - cont. 7-5 Implement the Massachusetts Scenic & Recreational Rivers Act within the region.	Beneficial Effects Positive step in initiating future alternatives of economic significance. Adverse Effects Average annual cost of administering and enforcing the program is estimated to be $5,000.	Beneficial or Adverse Effects Maintains present water quality. Insures preservation of stream character. Positive step in initiating future environmental alternatives.	Beneficial Effects Provides 1 skilled temporary part-time job. Adverse Effects Price of buildable land may go up which may adversely effect industrial and commercial activity.	Beneficial or Adverse Effects Psychological satisfaction from the action. Some landowners may be adverse to the action. Provides 1 skilled temporary part-time job.
7-6 Provide 4,500 feet of beach front within the region.	Beneficial Effects Provides an additional 400,000 activity days or about $800,000 in recreation benefits annually. Adverse Effects Average annual cost including O, M & R of about $450,000.	Beneficial or Adverse Effects Provides opportunity to maintain or increase landscape quality. Creation of swimming facilities. May modify 220 acres of forest land by clearing for beach and supporting facilities. May reduce quality of wildlife habitat on approximately 220 acres.	Beneficial Effects Will create 25 permanent semi-skilled jobs. Will create approximately 240,000 activity days or about $480,000 in recreation benefits annually to those within the region. May attract recreation oriented firms. Adverse Effects Loss of potential timber harvest on 220 acres of woodland.	Beneficial or Adverse Effects Will provide activity days for recreation opportunities. Will create 25 permanent semi-skilled jobs. Provides for more equitable distribution of recreation resources. Will create seasonal population influx. Psychological satisfaction from the action.
7-7 Establish greenbelt programs (similar to the Nashua River Greenway Program) on the Connecticut River and its major tributaries.	Beneficial Effects Provides additional activity days of recreation. Prevents increase in flood damageable properties. Adverse Effects Cost incurred to carry out the program.	Beneficial or Adverse Effects Maintains present water quality. Insures preservation of stream character.	Beneficial Effects Provides additional jobs. Adverse Effects Price of buildable land may go up which may adversely effect industrial and commercial activity.	Beneficial or Adverse Effects Psychological satisfaction from the action. Some landowners may be adverse to the action. Provides additional jobs.

TABLE 8.6 POTENTIAL ENVIRONMENTAL IMPACTS OF ALTERNATIVES

	ALTERNATIVES	SIGNIFICANT ENVIRONMENTAL IMPACTS ON: 1/															
		Erosion & Sedimentation	Water Table Changes	Changes Flow Regime	Changes Land Use	Upland Wild-life Habitat	Bottomland WL Habitat	Bottomland Hardwoods	Stream Fisheries	Wetlands	Rare or Endangered Animals, Plants	Intermittent Streams	Perennial Streams	Water Quantity	Water Quality Incl. Receiving Water	Appearance of the Landscape	Irreversible & Irretrievable Commitment of Resources 2/
1.1	Ignore loss of agricultural land	.	.	.	0	-	-	.	0	.	.	.	.	0	0	-	+
1.2	Preserve agricultural land	0	.	.	+	+	+	.	.	.	.	.	.	0	0	+	+
1.3	Increase forest management	0	.	.	.	.	.	+	.	.	.	.	.	0	0	0	+
1.4	Increase forest util. & mgt. incentives	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	+
1.5	Develop markets for forest products	0	.	.	.	.	.	.	.	.	.	.	.	.	.	0	+
1.6	Estab. forestry info & education program	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+
2.1	Participation in Flood Insurance Program	+	.	+	+	.	+	+	+	+	.	.	+	.	+	0	+
2.2	Structural flood protection	0	0	0	0	0	0	0	-	0	.	.	-	0	0	0	-
2.3	Floodproofing and nonstructural	.	.	.	.	.	.	.	.	0	.	.	-	.	0	0	-
2.4	Structural and floodproofing	0	0	0	0	0	0	0	-	0	.	.	-	0	0	0	-
3.1	Erosion & sediment control ordinances	+	.	.	.	+	+	+	+	+	.	+	+	.	+	+	+
3.2	Cropland erosion program	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+
3.3	Stream buffer zone	+	0	0	+	.	0	+	+	+	.	.	+	.	+	0	+
4.1	Wetlands acquisition	.	+	+	+	+	+	+	+	+	+	+	+	.	+	+	+
4.2	Expand wetland zoning	.	+	+	+	+	+	+	+	+	+	+	+	.	+	+	+
4.3	Accelerate Inland Wetland Restriction Pro.	.	+	+	+	+	+	+	+	+	+	+	+	.	+	+	+
5.1	Investigate potential water supplies	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+	+
5.2	Acquire or protect water supply sites	.	.	.	+	.	.	.	.	.	.	.	.	+	+	+	+
6.1	Complete soil surveys	+	+	.	+	+	+	+	+	+	.	+	+	.	+	+	+
7.1	Provide additional campsites	-	.	.	0	-	-	.	0	.	0	.	.	.	-	+	+
7.2	Provide additional picnic tables	-	.	.	0	-	-	.	0	.	0	.	.	.	-	0	+
7.3	Provide additional hiking trails	-	.	0	0	-	-	.	0	.	0	+	.	.	-	+	+
7.4	Natural areas acquisition	+	.	.	+	+	+	+	+	+	+	+	+	.	+	.	+
7.5	Massachusetts Scenic Recreation Rivers Act	+	+	+	+	.	+	+	+	+	.	.	+	.	+	+	+
7.6	Provide additional beach front	.	.	-	-	.	-	-	-	-	.	.	-	-	-	0	-
7.7	Establish greenbelts	+	.	.	+	.	+	+	.	+	+	.	+	.	0	+	+

1/ (+) Maintains or improves present situation. (-) Adverse impact expected. (0) Could have adverse and/or favorable impact. (.) No significant impact is expected.

2/ (+) No irreversible or irretrievable commitment of resources. (-) Involves an irreversible and irretrievable commitment of resources.

SCS PHOTO

Abbey Lake, a 36 acre pond in Sandisfield was constructed as a part of the PL 83-566 Clam River Watershed Project.

CHAPTER 9

PROGRAM IMPLEMENTATION of ALTERNATIVES

9.1 INTRODUCTION

This chapter identifies program opportunities available for implementing the alternatives identified in Chapter 8. Existing federal, state, and local programs are outlined, which will enable selected alternatives to be turned into action. The ultimate result of the Massachusetts Water Resources Study is hopefully not a mere list of alternatives to meet needs, but rather a catalyst for action designed to meet those needs.

9.2 OPPORTUNITIES FOR USDA PROGRAMS

Programs of agencies which are active or may be established in the region will be discussed. Ongoing programs should receive first priority when considering implementation of alternatives. New programs may require a number of years to get them set up and in operation. Table 9.1 summarizes programs and agencies applicable to the various alternatives. Programs are listed with the agency responsible for their administration.

9.2A Soil Conservation Service Programs

Conservation Operations Program -- This is the ongoing program of the Soil Conservation Service. Technical assistance is available through the county conservation districts for the planning and installation of measures to develop and conserve natural resources. Field offices located in Hadley, Pittsfield, and Holden provide this technical assistance in the Connecticut River Region.

Assistance is available to local communities in the establishment of Erosion and Sediment Control Ordinances (Alternative 3-1). Sample bylaws have been developed by the National Association of Conservation Districts and governmental research agencies. Communities can also utilize the ordinances of nearby communities for guidance. Personnel from the Soil Conservation Service can assist towns in recognizing the special erosion needs of their particular community.

Technical assistance is available to the conservation districts to prepare the Inventory of Cropland with Serious Erosion Problems (Alternative 3-2). Technical assistance is also available to landowners desiring to reduce erosion losses through the use of conservation practices.

Soil Survey Program -- Soil Surveys conducted by the Soil Conservation Service include the mapping, classification, correlation, and interpretation of soils according to national standards. Soil mapping has been completed for much of the Connecticut River Region (See Figure 5.17). Communities may accelerate the completion of mapping by sharing the cost of soil surveys within the town boundaries. The soil survey program of the Soil Conservation Service can be used to implement Alternative 6-1.

Soil surveys are an essential element for use in the identification of prime agricultural land and are a first step in any program to protect prime agricultural land from urban development. Alternative 1-2, Preserve Agricultural Land, relies on accurate soil survey data being available.

Public Law 83-566 -- The Small Watershed Protection and Flood Prevention Act provides technical and financial assistance to solve land and water problems. Flood prevention must be a major concern in each watershed. This act can be used to implement Alternatives 2-2, 2-4, and 5-1, and assist with Alternatives 7-1, 7-2, 7-3, and 7-6.

Federal cost sharing is available to provide 100 percent of the cost of structural measures to provide flood protection, and 50 percent of the cost of multipurpose reservoir storage allocated to recreation or fish and wildlife developments. Non PL-566 cost sharing must be provided by local sponsors who must also provide all necessary land rights needed for project installation.

At the present time, federal cost sharing for nonstructural or floodproofing methods of reducing flood damage is not available under PL-566 or other federal flood protection programs. PL-566 can, however, assist local communities to develop plans for nonstructural flood protection, if this is the most feasible and acceptable alternative. All installation costs must be borne by non PL-566 funds.

The structural measures studied for each watershed with significant damage predominantly include the use of floodwalls or earthen dikes to provide flood protection to an industry or business that sustains major damage. In many cases, residential damage remains, since there is no feasible system of protecting this property in most of the watersheds.

Public Law 83-566 requires that needed structural works of improvement not be single purpose local flood control measures or water development projects which could be more appropriately carried out with federal assistance provided under other authorities. This is the case for many of the strictly structural alternatives which protect the major damage area, usually an industry located along the banks of the river. PL-566 can, however, be utilized to plan and implement multiple-purpose projects and local protection measures combined with other water resource development.

Massachusetts Natural Resources Planning Program (MNRPP) -- This local initiative program enables communities to inventory their natural resources, to evaluate those resources against guidelines, and to determine the consequences of proposed actions on the natural resource base, and develop a natural resource plan for the community. A Natural Resources Technical Team is available to assist the townspeople to assess their resource, problems and opportunities for action. Graduate student interns are available to work with local residents to collect and analyze data.

The Massachusetts Natural Resources Planning Program is a useful tool in assessing the magnitude of resource problems and in developing courses of action to solve the problems. Preservation of Agricultural Land (Alternative 1-2), Wetlands Acquisition (Alternative 4-1), Conservancy Zoning (Alternative 4-3), and Natural Areas Acquisition (Alternative 7-4) should all be more easily implementable in a town participating in the Massachusetts Natural Resources Planning Program. Basic inventories needed for the program and the increased public awareness of the natural resource base will be useful in laying the foundations for implementation of alternatives.

Resource Conservation and Development Program (RC&D) -- A RC&D Area has been established in Berkshire and Franklin Counties, which includes about one-third of the region.

The RC&D Area can provide financial and technical assistance measures for critical area treatment for erosion and sediment control, flood prevention, farm irrigation, land drainage, public water-based recreation and fish and wildlife development, soil and water conservation management for agriculture-related pollution control, and water quality management.

The RC&D Program can serve as a vehicle for implementing Alternative 2-2, Structural Flood Protection Program, for measures where social or economic benefits to the area will result. Up to 100 percent federal cost sharing for technical assistance and structural measures for flood control is available. Local sponsors must provide all necessary land rights.

A RC&D Area could also assist in implementing Alternative 1-5, Establish a Program to Develop Diversified Markets for Low Quality Products, and with other forestry alternatives.

9.2B Forest Service Programs

Renewable Resources Program -- This is an "umbrella" program which combines many of the Forest Service authorities into a unified group of systems for recreation, wildlife, timber, land and water conservation, and human and community development. The Forest Service cooperates with the Massachusetts Department of Environmental Management, Division of Forests and Parks, to conduct forestry programs on state and privately owned forest land.

The Renewable Resources Program can provide assistance to forest landowners to Increase Management of Public and Private Forest Land (Alternative 1-3), assist in establishing a Program to Develop Diversified Markets for Forest Products (Alternative 1-5), and to assist in the establishment of an Information and Education Program to Inform Landowners About Benefits of Forest Management (Alternative 1-6).

9.2C Farmers Home Administration Programs

The FmHA has a number of loan and grant programs designed to encourage the economic development of rural areas. These programs can be used by the region's rural communities to help implement various alternatives.

Loans are available to assist sponsoring public agencies in Resource Conservation and Development Areas. Soil and water loans are designed to aid farm landowners to make better use of their farmland. Watershed Protection and Flood Prevention loans help PL-566 sponsors to provide the local cost of structural measures. In addition, loans and grants are available to improve rural water systems.

Farmers Home Administration loans and grants could assist in implementing Alternatives 1-1, 2-2, 2-4, 3-2, and 5-2.

9.2D Agricultural Stabilization and Conservation Service (ASCS)

Agricultural Conservation Program (ACP) -- This program places increased emphasis on rural pollution abatement, as well as: (1) providing incentives for landowners to carry out soil and water conservation practices where benefits in relation to costs are long deferred or that provide significant offsite benefits; (2) encouraging farmers and ranchers to carry out whole-farm long-term conservation plans that emphasize conservation benefits of national concern and aid in preventing pollution of air, soil and water. ACP will provide both technical and financial assistance to farmers whose land is a source

of agricultural pollution or affected by wind or water erosion. Cost sharing generally ranges from 50 to 75 percent but can range up to 90 percent on critical area problems where priorities have been developed by local committees. This program can aid in implementation of Alternatives 3-2 and 3-3 for reducing erosion and sediment.

Forestry Incentives Program (FIP) -- This is a production oriented program which provides federal cost sharing on tree planting and timber stand improvement to private landowners. Emphasis is placed upon:

1. Increasing the future supply of softwood sawtimber;

2. continued sustained yield, multi-purpose management of private nonindustrial forest land;

3. cost-effectiveness of forest improvement practices as measured by a continuing evaluation.

Cost sharing ranges from 50 to 75 percent. This program can aid in implementation of Alternatives 1-3 and 1-4 to preserve and improve forest land.

9.3 OPPORTUNITIES FOR OTHER PROGRAMS

Information on other federal assistance programs exist in the current "Catalog of Federal Domestic Assistance," Executive Office of the President, Office of Management and Budget, Washington, D.C.

Some of the federal programs applicable and pertinent to this study are discussed below:

9.3A Other Federal Programs

National Flood Insurance Program -- The Department of Housing and Urban Development, through the Federal Insurance Administration, provides communities with the opportunity to participate in the National Flood Insurance Program. Flood insurance is available through local agents for residents of towns which qualify for the program. In return for federally subsidized insurance rates, the community must agree to consider flood hazards before approving development and to severely limit development of flood prone areas. Twenty-one of the Connecticut River Region communities are not enrolled in the flood insurance program which implements Alternative 2-1, Flood Insurance.

Land and Water Conservation Fund -- The Land and Water Conservation Fund administered by the U.S. Department of the Interior, Heritage Conservation and Recreation Service provides cost sharing assistance to finance recreation and open space programs. The Fund could assist in implementing Alternatives 4-1, 7-1, 7-2, 7-3, and 7-4.

9.3B State Programs

Land Use Programs -- Recently enacted Agricultural Preservation and Restoration Act under Chapter 780 of the Acts of 1977, Massachusetts General Laws, will be administered by the Division of Conservation Services working in cooperation with local Conservation Commissions. Starting with a pilot program, the Act will seek to halt the development of critical farmland through state financing of the purchase of development rights (Alternative 1-2).

Chapter 232 of the Acts of 1977, Massachusetts General Laws, was enacted to enable cities and towns to borrow and appropriate funds for the purchase of development rights on farmland (Alternative 1-2).

The Horticultural Land Assessment Act under Chapter 61A of the General Laws can also be used in a multi-faceted approach to encourage the preservation of agricultural land use.

Forestry Programs -- The Department of Environmental Management, Division of Forests and Parks, cooperates with the U.S. Forest Service to assist forest landowners to make the best use of the forest resource. This program can aid in the implementation of Alternative 1-3, Increased Management of Forest Land, and Alternative 1-6, Information and Education to Inform Forest Landowners of Benefits of Management.

The Forest Land Assessment Act, General Laws, Chapter 61, can be used to maintain forest land in the face of rising real estate taxes, thus, helping to implement Alternative 1-4, Increase Incentives to Manage Forest Land.

Wetlands Programs -- The Wetlands Restriction Section of the Department of Environmental Management administers the Inland Wetlands Restriction Act. Increased staff or greater use of outside consultants will be necessary if Alternative 4-2, Accelerate Wetlands Restrictions, is to be accomplished.

The Massachusetts "Wetlands for Wildlife" program of the Division of Fisheries and Wildlife has purchased wetland areas in the region for their wildlife habitat value. This program can be utilized to implement Alternative 4-1, Wetlands Acquisition. The Division of Conservation Services could assist municipalities to acquire and develop outdoor facilities through the Massachusetts Self-Help program.

Recreational Programs -- The Department of Environmental Management is the agency which would be responsible for implementing the Massachusetts Scenic and Recreational Rivers Act (Alternative 7-5). The department has established a pilot program for the North River (Coastal Region) to gain experience in administering the act.

Reservoir Programs -- The Division of Water Resources of the Department of Environmental Management has funds available from a bond issue to acquire and protect potential reservoir sites as authorized under the Massachusetts General Laws, Chapter 757, Acts of 1970. Funds may be available from this source to investigate and protect potential surface water reservoir sites (Alternatives 5-1 and 5-2). The Massachusetts Self-Help Program, Chapter 132A, Section 11 of the Massachusetts General Laws can assist with acquisition of water supply sites and acquiring conservation lands for future use as water impoundment sites (Alternative 5-2).

9.3C Regional Programs

Regional planning agencies are the logical group to assist communities to establish erosion and sediment control ordinances (Alternative 3-1). Technical assistance and guidance is available from the Soil Conservation Service through the local Conservation District. A number of "model" ordinances are available which can be adapted to fit local conditions.

TABLE 9.1

IMPLEMENTATION OF ALTERNATIVES BY PROGRAM AND AGENCY
(Indicated by x)

ALTERNATIVES	Resource Cons. & Development (RC&D) Soil Cons. Service	Cons. Operations Soil Cons. Service	Soil Survey Soil Cons. Service	Small Watershed Program (PL-566) Soil Cons. Service	Natural Resources Planning Program Soil Cons. Service	Renewable Resources Program Forest Service	Agri. Cons. Program (ACP) Agri. Stabilization & Cons. Serv.	Forestry Incentives Program (FIP) Agri. Stabilization & Cons. Serv.	Loans & Grants Farmers Home Administration	National Flood Insurance Dept. of Housing & Urban Development	Land & Water Cons. Fund Heritage Cons. & Rec. Service, USDI	Potential Reservoir Funds (DWR) Dept. of Environmental Management	Forestry Programs Dept. of Environmental Management	Wetlands Restriction Program Dept. of Environmental Management	Recreation Programs Dept. of Environmental Management	Wetlands for Wildlife Dept. of Fish & Wildlife & Rec. Veh.	Self-Help Program Div. of Cons. Services	Regional Planning Agencies	Horticultural Land Assessment Act Cities & Towns	Agri. Land Acquisition & Preservation Mass. Dept. of Agriculture
1.1 Ignore loss of agricultural land	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.2 Preserve agricultural land	.	.	x	.	x	.	x	.	x	.	.	.	.	.	.	.	.	.	x	x
1.3 Increase forest management	x	x	.	.	.	x	x	x	.	.	.	.	x	.	.	.	.	.	.	.
1.4 Increase forest utilization & mgt. incentives	.	x	.	.	.	x	x	x	.	.	.	.	x	.	.	.	.	.	.	.
1.5 Develop markets for forest products	x	.	.	.	.	.	.	x	.	.	.	.	x	.	.	.	.	.	.	.
1.6 Estab. forestry info & education program	x	.	.	.	.	x	.	x	.	.	.	.	x	.	.	x	.	.	.	.
2.1 Participation in Flood Insurance Program	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
2.2 Structural flood protection	x	.	.	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
2.3 Floodproofing and nonstructural	x	.	.	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
2.4 Structural and floodproofing	x	.	.	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
3.1 Erosion & sediment control ordinances	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
3.2 Cropland erosion program	.	x	x	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.
3.3 Stream buffer zone	.	x	.	.	x	.	.	.	.	.	x	.	.	.	.	.	x	x	.	.
4.1 Wetlands acquisition	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x	x	.	.	.
4.2 Expand wetland zoning	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
4.3 Accelerate Inland Wetland Restriction Program	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
5.1 Investigate potential water supplies	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.
5.2 Acquire or protect water supply sites	.	.	.	.	.	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.
6.1 Complete soil surveys	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7.1 Provide additional campsites	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.	.	.	.	.	.
7.2 Provide additional picnic tables	x	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.	.	.	.	.
7.3 Provide additional hiking trails	x	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.	x	.	.	.
7.4 Natural areas acquisition	x	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.	x	.	.	.
7.5 Massachusetts Scenic Recreation Rivers Act	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	x	.	.	.
7.6 Establish greenbelts	x	.	.	.	x	.	.	.	.	.	x	.	.	.	.	x	x	.	.	.
7.7 Provide additional beach fronts	x	.	.	x	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.

CONNECTICUT RIVER REGION

APPENDIX A

Prime Potential Reservoir Sites

1. Summary

The potential reservoir sites which are presented in this appendix (Table A.1, Figure A.1) represent the prime possibilities for permanent water storage sites in the Connecticut River Region which are not already under active consideration for development. Topography, geology, and affected man-made facilities appear to be favorable. More detailed geologic and engineering investigations need to be made before sites are selected and acquired. If future needs for a reservoir site in a particular area can be identified, steps should be taken to acquire the site at an early date so that development in the area does not make reservoir costs excessive. Early acquisition or protection of these potential reservoir sites is essential to conserve these important natural resources for future use.

2. Previous Studies

The Soil Conservation Service has completed and published inventories of potential reservoir sites in the region. Reservoir locations were selected on the basis of suitable topography, relatively undeveloped pool areas, and certain drainage area, pool area, and storage characteristics. Inventory data which was prepared included a surficial geologic investigation, list of man-made facilities which would be inundated and preliminary designs and cost estimates for various levels of development.

The inventories provide a valuable source of basic information about more than 626 potential reservoir sites in the region. No attempt was made in the inventories to evaluate the potential of the sites for specific purposes such as water supply, recreation, etc. Unfortunately, many of the sites which first appear promising fail to meet the more stringent criteria required for a good water supply or low-flow augmentation reservoir. Among the more common problems are poor geologic conditions, recent development of the pool area, and extremely high cost.

3. Site Evaluation

The purpose of this appendix is to present the most promising potential reservoir sites in the Connecticut River Region. Inventories of potential sites for the Chicopee, Millers, Deerfield, Westfield, Farmington, and the Northern, Central, and Southern Connecticut Valley Study Areas

were used as the source of basic data. Many sites were quickly eliminated from further consideration because of their small drainage area or because of obvious problems connected with geologic conditions and extensive effects on man-made facilities.

The remaining sites were individually evaluated for potential uses. Table A-1 summarizes information for the sites which appear to have potential for permanent storage of water. More detailed information concerning the individual sites is available in the Inventory of Potential and Existing Reservoir Sites for the particular area.

4. Protection of Sites

These potential reservoir sites are an important natural resource. They are examples of unique situations combining suitable topography to provide efficient storage, good geologic conditions which limit excessive seepage losses, and relatively undeveloped, lower cost, reservoir areas. Many of the potential reservoir sites in Massachusetts have been lost for future utilization through poor or uninformed land use decisions. Residential and commercial development in the state has encroached on the potential reservoir area of a number of otherwise suitable sites. In many instances, wetland protection measures have been effective in preserving the stream and the adjoining wetlands. However, the higher nonwetland areas which would be needed to provide deep water storage potential have been subject to development with little restriction. As a result, a potential deep water storage site with good geology may be economically infeasible because of the high cost involved in removing existing development.

State and local governments must begin to recognize the importance of protecting this dwindling natural resource--the natural potential reservoir site--from loss through default. The result of inaction in this area will not be catastrophic. Loss of a potential reservoir site is a more subtle loss which may not become apparent for several years until needs for water supply or water-based recreation cannot be easily or economically met. Then it will become apparent that preservation of these sites would have been in the public interest. The purchasing of houses in a potential water supply reservoir is socially disruptive to a community as well as being highly expensive. Development in a potential recreation or fishing pool area usually represents the loss of the site as costs per surface acre become prohibitive. It would appear to be more prudent to establish a program of early acquisition of potential reservoir sites in order to safeguard the areas from development pressures.

All of the data which has been prepared for the potential site inventories is based on preliminary data which should be substantiated and reinforced before site acquisition is undertaken. Among the most

important items which need to be thoroughly investigated before acquisition is subsurface geologic conditions to ascertain the materials which are present and the potential for seepage into the ground water. Current appraisals of land costs by competent professionals are also needed.

If a future need for a site can be identified; and if the detailed studies show the site to offer practical potential, steps should be undertaken to limit development of the area. Purchase of the site is one possibility. Acquisition of development rights is another. A third possibility might be donation of the land for conservation purposes by public-spirited citizens. Even if acquisition of a potential reservoir area does not appear feasible, governments can take steps to make development compatible with future use of the area. Highway locations can be realigned to skirt reservoir sites. Developers can be encouraged to keep potential pool areas as undeveloped green space to complement the developed areas. Town boards can avoid locating schools, sanitary landfills, and other municipal improvements on potential reservoir areas.

If steps are not taken to protect these potential reservoir sites from unwise or uninformed development, they will likely be too costly to acquire in the future. They will be lost for future reservoir use unless timely action is undertaken to protect and preserve them to meet anticipated needs.

TABLE A.1

PRIME POTENTIAL RESERVOIR SITES CONNECTICUT RIVER REGION

Site No.	Location City/Town	Drainage Area (sq mi)	WATER SUPPLY: Pool Elevation Mean Sea Level (ft)	WATER SUPPLY: Volume (million gallons)	WATER SUPPLY: Yield (million gallons per day)	WATER SUPPLY: Maximum Depth (ft)	LOW FLOW AUGMENTATION: Pool Elevation Mean Sea Level (ft)	LOW FLOW AUGMENTATION: Volume (ac-ft)	LOW FLOW AUGMENTATION: Augmentation Flow for 120 Days (c.f.s.)	RECREATION: Pool Elevation Mean Sea Level (ft)	RECREATION: Area (ac)
CP-2902[1/]	Phillipston	3.4	1002	479	1.9	10	1002	1330	5.6	1001	234
CP-2905	Hubbardston	1.4	1039	312	0.9	42	1032	560	2.3	1051	84
CP-2907	Hubbardston	2.9	894	660	2.1	45	940	1140	4.8	964	146
CP-2909	Hubbardston	6.9	962	655	3.0	62	970	2710	11.4	962	82
CP-2913	Barre	1.1	1052	86	0.4	22	1056	420	1.8	1052	41
CP-2918	Barre	1.0	858	235	0.7	38	854	440	1.9	858	69
CP-2920	Rutland	1.4	1039	214	0.8	18	1038	530	2.2	1039	81
CP-2921	Rutland	1.0	972	162	0.6	32	972	460	1.9	972	61
CP-2922	Barre	3.6	984	799	2.5	22	980	1520	6.4	984	262
CP-2924	Barre	4.4	965	592	2.4	41	966	1910	8.0	972	206
CP-2927	Rutland	2.5	982	389	1.5	18	982	1120	4.7	982	121
CP-2928	Hardwick	7.2	848	1580	5.1	68	834	2970	12.5	872	223
CP-2932	Oakham	1.4	1011	223	0.8	19	1010	620	2.6	1028	81
CP-3004	Hardwick	1.7	912	154	0.7	22	916	660	2.8	912	50
CP-3006	Hardwick	3.3	842	479	1.9	22	842	1370	5.8	842	159
CP-3007	Hardwick	4.8	742	820	2.9	92	734	1930	8.1	742	71
CP-3101	Hardwick	1.6	968	154	0.7	19	970	770	3.2	966	86
CP-3103	Hardwick	3.2	709	707	2.2	36	703	1480	6.2	722	152
CP-3111	Hardwick	2.3	547	346	1.3	42	547	1060	4.5	558	81
CP-3202	Oakham	1.5	850	338	1.0	55	842	650	2.8	866	71
CP-3206	Paxton	2.2	942	485	1.5	42	938	890	3.7	942	141
CP-3207	Paxton	4.3	907	582	2.4	36	908	1810	7.6	922	106
CP-3209	New Braintree	1.9	911	297	1.2	28	908	734	3.1	918	119
CP-3211	Leicester	2.4	1005	463	1.6	33	1000	930	3.9	1012	158
CP-3217	No. Brookfield	2.1	852	220	1.0	50	858	860	3.6	852	34
CP-3232	No. Brookfield	2.2	652	250	1.1	34	654	870	3.7	652	72
CP-3233	E. Brookfield	1.6	632	105	0.6	16	640	620	2.6	632	35
CP-3238	Warren	1.4	642	370	1.1	28	634	530	2.2	642	78
CP-3243	Warren	2.6	731	570	1.8	51	722	1100	4.6	749	109
CP-3244	Brookfield	1.5	642	298	1.0	42	638	680	2.9	642	54
CP-3249	Warren	1.9	692	339	1.2	76	686	800	3.4	708	59
CP-3250	Warren	1.3	624	240	0.8	33	620	530	2.2	632	66
CP-3314	Palmer	1.0	554	98	0.5	34	554	301	1.3	581	52
CP-3320	Brimfield	1.3	978	212	0.8	28	975	468	2.0	982	82

1/ CP - Chicopee

TABLE A.1 - cont. PRIME POTENTIAL RESERVOIR SITES CONNECTICUT RIVER REGION

			WATER SUPPLY				LOW FLOW AUGMENTATION			RECREATION	
Site No.	Location City/Town	Drainage Area (sq mi)	Pool Elevation Mean Sea Level (ft)	Volume (million gallons)	Yield (million gallons per day)	Maximum Depth (ft)	Pool Elevation Mean Sea Level (ft)	Volume (ac-ft)	Augmentation Flow for 120 Days (c.f.s.)	Pool Elevation Mean Sea Level (ft)	Area (ac)
DE-1001[1/]	Leyden	1.9	642	89	0.5	42	660	640	2.7	642	15
DE-1003	Leyden	1.2	790	318	0.9	61	786	490	2.1	812	63
DE-1004	Colrain	1.3	773	318	0.9	68	764	580	2.4	786	67
DE-1009	Shelburne	3.2	724	833	2.2	71	708	1270	5.4	738	137
DE-1011	Greenfield	9.3	262	1950	5.6	56	256	3820	16.1	262	380
DE-1101	Monroe	3.6	1992	555	1.9	92	1988	1450	6.1	1992	55
DE-1106	Rowe	1.0	1572	238	0.7	52	1562	430	1.8	1586	51
DE-1112	Rowe	4.1	1428	925	2.6	71	1422	1840	7.8	1440	242
DE-1115	Charlemont	13.3	715	318	2.4	86	740	1970	8.3	715	36
DE-1116	Monroe	6.9	1819	616	2.6	84	1832	2820	11.9	1819	70
DE-1201	Florida	4.7	1725	721	2.4	90	1720	1870	7.8	1725	66
DE-1203	Savoy	1.4	1871	332	0.9	21	1864	560	2.4	1878	87
DE-1207	Florida	1.4	1892	249	0.8	29	1888	570	2.4	1908	74
DE-1208	Savoy	2.4	1562	540	1.5	40	1552	940	4.0	1579	97
DE-1209	Savoy	2.2	1923	488	1.4	63	1914	909	3.8	1937	125
DE-1213	Savoy	2.8	1593	617	1.7	57	1586	1210	5.1	1607	164
DE-1308	Hawley	1.6	1641	405	1.1	41	1628	660	2.8	1652	71
DE-1401	Hawley	2.6	1658	546	1.1	68	1634	500	2.1	1658	65
DE-1611	Conway	5.5	723	481	2.0	65	730	2090	8.8	723	79
DE-1614	Ashfield	1.9	925	452	1.2	43	966	820	3.4	989	86
DE-1622	Conway	5.5	872	862	2.9	56	868	2240	9.4	892	154
DE-1623	Conway	15.3	868	3485	9.8	78	854	6320	26.6	880	436
DE-1629	Conway	1.4	477	269	0.8	44	470	570	2.4	498	53
MI-0202[2/]	Ashburnham	4.5	1155	810	2.5	27	1152	1810	7.6	1162	260
MI-0203	Ashburnham	1.0	1112	265	0.68	22	1106	370	1.6	1109	66
MI-0216	Phillipston	3.0	974	604	1.7	12	972	1380	5.8	968	202
MI-0217	Athol	1.1	1028	197	0.6	18	1026	490	2.1	1028	71
MI-0304	Royalston	13.7	995	2200	7.1	37	1060	40	0.2	1002	732
MI-0305	Royalston	3.5	891	776	2.2	41	882	1440	6.1	908	153
MI-0307	Warwick	1.0	943	235	0.64	73	932	440	1.8	962	47
MI-0308	Warwick	1.8	848	401	1.1	63	836	720	3.1	867	67
MI-0310	Royalston	1.8	994	401	1.1	44	990	840	3.5	1002	112
MI-0311	Royalston	16.5	952	1275	5.4	96	960	5150	21.7	952	152
MI-0312	Royalston	3.7	902	492	1.7	21	903	1600	6.7	902	310
MI-0313	Warwick	5.5	725	1202	3.3	50	714	2160	9.1	744	213
MI-0402	Orange	1.7	700	388	1.0	50	692	710	3.0	714	83
MI-0403	Orange	1.1	780	257	0.7	50	770	470	2.0	797	49

1/ DE - Deerfield
2/ MI - Millers

TABLE A.1 - cont. PRIME POTENTIAL RESERVOIR SITES CONNECTICUT RIVER REGION

			WATER SUPPLY				LOW FLOW AUGMENTATION			RECREATION	
Site No.	Location City/Town	Drainage Area (sq mi)	Pool Elevation Mean Sea Level (ft)	Volume (million gallons)	Yield (million gallons per day)	Maximum Depth (ft)	Pool Elevation Mean Sea Level (ft)	Volume (ac-ft)	Augmentation Flow for 120 Days (c.f.s.)	Pool Elevation Mean Sea Level (ft)	Area (ac)
MI-0404[1/]	Orange	5.9	632	1294	3.6	38	624	2340	9.9	649	278
MI-0405	Orange	7.2	603	1591	4.4	52	596	3160	13.3	617	426
MI-0407	Orange	1.1	619	203	0.6	18	616	440	1.9	619	68
MI-0409	Athol	1.6	832	110	0.5	11	836	700	3.0	832	83
MI-0410	Orange	1.3	612	294	0.8	28	608	546	2.3	612	87
MI-0501	Warwick	1.3	882	215	0.7	22	882	610	2.6	882	82
MI-0502	Warwick	2.5	852	284	1.0	18	854	1060	4.4	852	131
MI-0504	Warwick	3.4	846	613	1.9	56	842	1330	5.6	846	152
MI-0506	Warwick	5.8	751	1284	3.5	56	740	2540	10.7	774	185
MI-0507	Warwick	11.5	655	2025	6.2	34	652	4720	19.8	662	653
MI-0508	Warwick	8.4	672	1840	5.1	72	660	3410	14.3	692	319
MI-0603	Northfield	1.8	875	400	1.1	25	871	860	3.6	882	124
MI-0605	Erving	3.1	833	608	1.8	53	825	1300	5.5	855	151
WE-3603[2/]	Savoy	2.4	1939	408	1.5	29	1936	890	3.7	1944	159
WE-3606	Ashfield	1.6	1583	351	1.1	38	1576	670	2.8	1592	92
WE-3608	Plainfield	4.5	1434	994	3.2	64	1422	1850	7.8	1454	183
WE-3609	Ashfield	4.9	1428	1087	3.5	48	1420	2080	8.8	1442	267
WE-3611	Ashfield	1.6	1435	370	1.2	56	1426	720	3.0	1449	90
WE-3612	Windsor	2.5	1937	551	1.8	47	1932	1140	4.8	1947	160
WE-3614	Ashfield	4.5	1280	991	3.2	44	1272	1970	8.3	1294	247
WE-3615	Ashfield	2.4	1356	527	1.7	34	1348	1000	4.2	1370	130
WE-3616	Cummington	3.3	1153	726	2.3	43	1144	1410	5.9	1172	125
WE-3618	Cummington	5.8	1188	1210	3.9	76	1174	2430	10.2	1212	160
WE-3619	Goshen	6.2	1242	1367	4.4	54	1232	2550	10.7	1264	219
WE-3622	Goshen	2.2	1257	485	1.5	33	1250	840	3.5	1270	125
WE-3624	Chesterfield	2.8	1211	392	1.6	32	1210	1130	4.8	1218	126
We-3625	Chesterfield	4.5	1142	990	3.2	34	1134	1920	8.1	1159	205
WE-3626	Chesterfield	1.3	1242	64	0.4	12	1248	570	2.4	1242	45
WE-3627	Worthington	3.7	1197	826	2.6	39	1190	1600	6.7	1208	238
WE-3628	Worthington	4.1	1207	453	2.0	57	1212	1810	7.6	1207	74
WE-3630	Worthington	2.0	1020	310	1.2	26	1018	770	3.2	1038	114
WE-3631	Chesterfield	13.8	1115	3013	9.6	55	1106	5780	24.3	1132	630
WE-3701	Peru	2.2	1800	485	1.5	70	1788	888	3.7	1819	86
WE-3706	Middlefield	1.0	1126	184	0.6	41	1122	430	1.8	1132	53
WE-4301	Granville	1.3	921	924	0.9	71	912	580	2.4	936	62

1/ MI - Millers
2/ WE - Westfield

D

TABLE A.1 PRIME POTENTIAL RESERVOIR SITES CONNECTICUT RIVER REGION

			WATER SUPPLY				LOW FLOW AUGMENTATION			RECREATION	
Site No.	Location City/Town	Drainage Area (sq mi)	Pool Elevation Mean Sea Level (ft)	Volume (million gallons)	Yield (million gallons per day)	Maximum Depth (ft)	Pool Elevation Mean Sea Level (ft)	Volume (ac-ft)	Augmentation Flow for 120 Days (c.f.s.)	Pool Elevation Mean Sea Level (ft)	Area (ac)
FA-5306 1/	Otis	1.6	1551	357	1.1	30	1547	764	3.2	1562	102
FA-5307	Otis	1.8	1525	349	1.2	35	1521	749	3.1	1532	109
FA-5308	Otis	3.9	1420	866	2.7	28	1415	1804	7.6	1432	244
FA-5403	Otis	1.4	1383	322	1.0	33	1378	650	2.7	1392	85
FA-5501	Otis	1.1	1501	181	0.6	9	1500	430	1.8	1496	53
FA-5503	Sandisfield	2.2	1462	451	1.5	32	1456	930	3.9	1472	110
FA-5604	Sandisfield	1.2	1311	203	0.7	31	1310	560	2.4	1330	66
FA-5607	Tolland	1.7	1231	363	1.2	61	1222	670	2.8	1242	88
FA-5608	Sandisfield	1.6	1190	355	1.1	20	1132	1050	4.4	1197	104
FA-5701	Sandisfield	1.7	1488	377	1.2	50	1478	700	2.9	1505	75
FA-5704	Sandisfield	1.7	1341	336	1.1	21	1338	780	3.3	1347	114
FA-5801	Tolland	1.1	1296	186	0.7	37	1294	490	2.1	1302	56
FA-5802	Tolland	3.4	1323	856	1.8	34	1308	860	3.6	1323	140
FA-5806	Tolland	9.7	1166	2123	6.8	58	1158	4208	17.7	1184	440
NC-0803 2/	Warwick	3.2	884	654	1.9	34	880	1410	5.9	892	195
NC-0806	Northfield	1.1	372	230	0.6	28	368	440	1.8	372	65
NC-0810	Gill	2.6	322	332	1.1	20	324	1200	5.1	322	124
NC-0812	Gill	1.0	397	174	0.5	27	394	410	1.7	402	55
NC-0902	Leyden	1.1	832	264	0.7	47	822	460	1.9	848	50
NC-0904	Bernardston	2.3	636	516	1.4	75	626	990	4.2	652	90
NC-0906	Gill and Greenfield	33.1	257	1180	6.8	62	270	6370	26.8	257	193
CV-1704 3/	Montague	3.4	272	458	1.9	54	272	1420	6.0	282	111
CV-1804	Wendell	1.2	936	209	0.7	36	934	530	2.2	942	65
CV-1805	Montague	1.4	555	312	0.9	45	546	570	2.4	571	62
CV-2007	Whately	9.9	372	335	2.3	48	380	1640	6.9	372	68
CV-2009	Northampton	2.9	202	567	1.9	24	198	1120	4.7	202	152
CV-2201	Williamsburg	3.1	852	692	2.2	52	844	1310	5.5	867	143
CV-2202	Williamsburg	7.4	766	1613	5.2	71	754	3090	13.0	788	286
CV-2206	Williamsburg	8.8	794	1936	6.2	64	780	3660	15.4	821	245
CV-2207	Williamsburg	4.8	432	461	2.1	22	436	2260	9.5	432	201
CV-2209	Williamsburg	1.8	936	409	1.3	46	924	730	3.1	954	78
CV-2210	Northampton	10.7	436	2340	7.5	36	426	4200	17.6	452	415
CV-2211	Westhampton	1.2	1050	286	0.9	50	1042	550	2.3	1065	63
CV-2212	Northampton	1.4	542	129	0.6	24	544	490	2.1	542	57
CV-2402	Westhampton	1.0	1156	100	0.5	26	1160	410	1.7	1182	57

1/ FA - Farmington
2/ NC - Northern Connecticut Valley
3/ CV- Central Connecticut Valley

TABLE A.1 - cont. PRIME POTENTIAL RESERVOIR SITES CONNECTICUT RIVER REGION

			WATER SUPPLY				LOW FLOW AUGMENTATION			RECREATION	
Site No.	Location City/Town	Drainage Area (sq mi)	Pool Elevation Mean Sea Level (ft)	Volume (million gallons)	Yield (million gallons per day)	Maximum Depth (ft)	Pool Elevation Mean Sea Level (ft)	Volume (ac-ft)	Augmentation Flow for 120 Days (c.f.s.)	Pool Elevation Mean Sea Level (ft)	Area (ac)
CV-2405 1/	Westhampton	2.1	1039	180	0.9	47	1048	860	3.6	1084	72
CV-2407	Westhampton	3.1	897	638	2.1	92	882	1270	5.3	897	49
CV-2408	Northampton	1.0	375	229	0.7	30	368	390	1.6	382	62
CV-2411	Southampton	1.1	632	141	0.6	12	632	440	1.8	632	71
CV-2416	Southampton	1.1	347	205	0.7	18	344	420	1.8	352	68
CV-2502	Belchertown	1.5	321	238	0.9	17	320	600	2.5	321	99
CV-2504	Granby	1.0	321	179	0.6	21	320	460	1.9	322	64
SC-4801 2/	Springfield	4.4	148	444	2.0	48	154	1840	7.7	148	66
SC-4806	Longmeadow	3.7	88	136	0.9	26	100	1110	4.7	88	39
SC-5002	Agawam	1.6	178	132	0.6	14	180	610	2.6	178	76
SC-5003	Southwick	1.0	222	131	0.6	10	222	370	1.5	222	69
SC-5004	Agawam	5.4	191	699	2.9	25	192	2280	9.6	198	251
SC-5104	Hampden	1.3	531	307	0.9	45	524	580	2.5	542	78
SC-5109	E. Longmeadow	1.4	242	161	0.7	9	244	680	2.9	241	92
SC-5111	Hampden	3.6	474	232	2.5	74	464	1570	6.6	492	151
SC-5114	Monson	1.0	585	157	0.6	35	584	440	1.9	592	41

1/ CV - Central Connecticut Valley
2/ SC - Southern Connecticut Valley

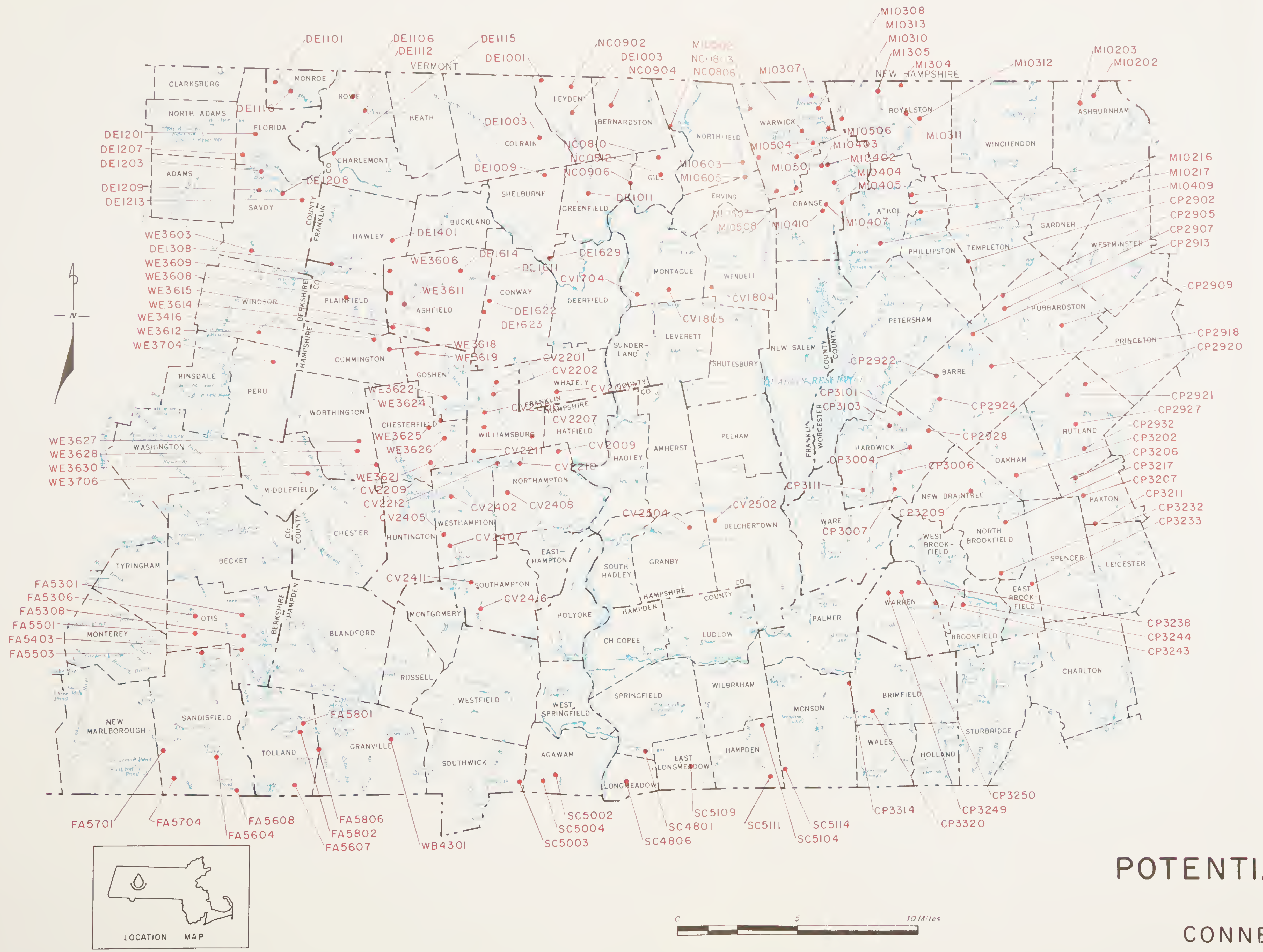

FIGURE A.1

POTENTIAL RESERVOIR SITES

CONNECTICUT RIVER REGION

MASSACHUSETTS

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

APPENDIX B

Wetland Evaluation Criteria

This section contains the criteria used to evaluate major wetlands in the Connecticut River Region. Each of the 79-wetlands evaluated was subjected to map study and a field examination. Ratings were assigned based on point values obtained for various attributes. Rationale for each evaluation item is also contained in this appendix to explain the background concerning development of the criteria.

The wetland evaluation criteria were developed by an interdisciplinary team of USDA specialists. Draft criteria were circulated among federal, state and regional agencies for comments and suggestions.

The criteria, with modifications, may be helpful in assessing the smaller wetlands of a community. Development of the evaluation procedure was based upon a regional approach and certain criteria, such as size, may need to be altered to fit local situations. The numerical rating values might also need to be modified to account for factors which might be important from a local basis but insignificant on a regional scale.

WETLAND EVALUATION

Wetland Name ______________________________ No. ____ Date ________

Wetland Location (City or Town) ______________________________

Investigator ______________________________

Ownership (Public - give name; or Private) ______________________________

Size (acres) ________ Drainage System ______________________________

Type Classification (acres per type) ______________________________

____

Surrounding Topography ______________________________

Flora ______________________________

____

Fauna ______________________________

____

Current Use ______________________________

Adjacent Land Use ______________________________

Nearness to Houses, etc. ______________________________

Potential Pollution Problem ______________________________

Accessibility ______________________________

Potential Storage Depth at Outlet ________ft. (vertical distance from normal water level to top of control structure)

Size of outlet structure if any ______________________________

Rating Summary

Forest Management ________________ Recreation ________________

Flood Control ________________ Uniqueness ________________

Fish Habitat ________________ Visual Quality ________________

Wetland Wildlife Habitat ________________

Comments

____

____

____

____

WETLAND EVALUATION

Wetland Name ____ No. ______

FOREST MANAGEMENT 1/

CRITERION	RANGE	Circle Correct RATING
1. Public ownership of forested wetland	>30%	3
	15-30%	2
	<15%	1
2. Stand size class distribution 2/ (sawtimber, poletimber, seedling-sapling)	<80% in any 2 classes	3
	>80% in any 2 classes	2
	>80% in any 1 class	1
3. Portion of forest land with 81-100% crown closure	>80%	6
	30-80%	4
	<30%	2
4. Portion of wetland forested	>60%	3
	30-60%	2
	<30%	1
5. Predominant forest cover type	Cedar, red maple, larch/ tamarack or green ash	9
	Hemlock, black ash or black spruce	3
6. Shape of forested wetland	Block	3
	Long narrow strip	1
7. Type of soil	Mineral	6
	Peat	2
8. Accessibility	Roads in wetland	6
	Roads leading to but not in wetland	4
	No roads leading to wetland	2

Total circled items: _________

RATING: Greater than 28 = High
24 to 28 = Moderate
Less than 24 = Low

Rating is: ___________________

1/Wetlands containing less than 5 acres of forest should not be rated. Insert NR in rating blank.

2/ If wooded areas are inaccessible for inspection MacConnell's height classes may be used:

Classes 1 & 2	Seedling-Sapling	Class 5	Sawtimber
Classes 3 & 4	Poletimber	Class 6 -	rates high (3)

WETLAND EVALUATION

Wetland Name ____ No. _____

FLOOD CONTROL

CRITERION	RANGE		Circle Correct RATING
1. Effective storage of wetland on total watershed above.	<1" runoff		0
	1"-3" runoff		6
	>3" runoff		9
2. Effective storage of upstream reservoirs and wetlands on total watershed.	<1" runoff		3
	1"-3" runoff		2
	>3" runoff		1
3. Effective storage on main stem between wetland and Potential Damage Area or major confluence.	<1" runoff		8
	1"-3" runoff		4
	>3" runoff		0
4. Distance downstream to Potential Damage Area	<1 mile		3
	1-5 miles		1
	over 5 miles		0
5. Severity of Potential Flood Damage (downstream)	<3 miles	Low	2
		Moderate	4
		High	8
	or		
	3-5 miles or below major confluence	Low	1
		Moderate	2
		High	4

Total circled items: _____

RATING: Total is: Less than 15 = Low
15 to 23 = Moderate
24 or greater = High   RATING is: __________

WETLAND EVALUATION

Flood Control

Instructions for Each Item on the Evaluation Sheet

1. The effective storage can be estimated by expected increase in wetland water elevation (a) during a large (approx. 100 year) flood times (x) the wetland area times (x) 12 divided by the drainage acres.

   $$\text{Effective Storage (in inches runoff)} = \frac{\text{Change in elevation x wetland area x 12}}{\text{drainage acres}}$$

   (a) Where there is a control at outlet of wetland, change in elevation will be estimated by field observation. Where there is no control, use attached curves.

2. Effective storage of upstream reservoirs and wetlands is estimated as under Item 1 and includes all storage in the drainage area above the wetland being evaluated, but not the wetland storage.

3. Effective storage on the main stem below the wetland being evaluated and the major part of the damage area. This is the storage of the downstream channel or wetland (inches) divided by the total drainage above the damage area (acres).

4. This is a visual estimate using aerial photos, quad sheets, personal knowledge or observation.

5. This is to be a comparison rating based on aerial photos, quads, personal knowledge and observation. Damage which might occur to that which replaces and surrounds the wetland should also be considered.

   Potential Damage: Low - agriculture, scattered residences, secondary roads
   Moderate - >low but <high
   High - concentrated residences, commercial, industrial, primary roads.

Limitation of Wetland Rating

The following system of evaluating wetlands as to their effectiveness in controlling floodwaters categorizes the wetland as: low, medium or high. No attempt should be made to compare wetlands within a category on the sole basis of the numerical rating.

Procedure for Wetland Evaluations

1. Use one sheet for each wetland.
2. Begin at upper end of drainage and work downstream.
3. The downstream wetland of two wetlands in series should be partially completed before rating the upper wetland.

Wetland or Other Control	Drainage (ac.)	Storage (ac./ft.)	Storage (in.)	Upstream Storage (ac./ft.)	Upstream Storage (in.)	Downstream Storage (ac./ft.)	Downstream Storage (in.)

This table is to be completed on drainages with more than one wetland.
Wetland areas should be listed working downstream.

WETLAND EVALUATION

Wetland Name ______________________________ No. ______

FISH HABITAT 2/

Circle the correct rating for each line entry.

	(a) High	(b) Moderate	(c) Low
1. Principal wetland type 1/	5	4 (with some type 5 present)	Other
2. Size (acres of Type 5) 1/	50+	>25 but <50	<25
3. Location of wetland	Immediately adjacent to a lake which supports warm water fish.	Immediately adjacent to a perennial stream that supports warm water fish.	Adjacent to intermittent stream or cut off from streams.
Presence of fish cover	Abundant	Limited	Scarce
Presence of game fish (number of species present)	2 or more	1	None

Total number of items circled in (a) _____ (b) _______

Calculation:
No. circled in column (a) x 2 + no. circled in column (b) x 1 = _________

RATING: Total is: 8 to 10 = High
5 to 7 = Moderate
0 to 4 = Low

RATING IS: _________

1/ Wetland type pertains to those described in Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service, United States Government Printing Office, Washington, D.C., 1971.

2/ There must be some type 5 present to evaluate the wetland for this use. If not rated insert NR in rating blank.

WETLAND EVALUATION

Wetland Name ______________________________ No. ________

WETLAND WILDLIFE HABITAT

Circle the correct rating for each line entry.

	(a) High	(b) Moderate	(c) Low
1. Principal wetland type 1/	3 or 4	5, 6 or 7	1, 2 or 8
2. Number of wetland types 1/	3 or more	2	1
3. Diversity of adjacent land use (other than urban types) 2/	3 or more	2	1
4. Percent of perimeter with 300'+ wide buffer strip 3/	80%+	60%+ but <80%	<60%
5. Size (acres)	200 or more	100+ but <200	<100
6. Islands	Yes	---	No
Total number of items circled in:	(a) _____	(b) _____	

Calculation:
No. circled in column (a) x 2 + no. circled in column (b) x 1 = ________

RATING: Total is: 9 to 12 = High
5 to 8 = Moderate
0 to 4 = Low RATING IS: ____________

1/ Wetland type pertains to those described in Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, United States Government Printing Office, Washington, D.C., 1971.

2/ The following types will qualify for the diversity determination:
1 type - forestland (any or all type(s) present will collectively constitute the equivalent of one diversity type)
1 type - unused tillable (TU), pasture (T), orchard (O)
1 type - abandoned field (AF), abandoned orchard (AO)
1 type - sand or gravel removal (SG) (inactive)
1 type - recreation land--any one or more of the following types:
RG - golf course, RD - golf driving range, RSK - ski area,
RFG - fairground, RP - urban park

3/ Buffer strip = area adjacent to wetland perimeter without occupied buildings or other urban uses.

WETLAND EVALUATION

Wetland Name ____ No. ______

RECREATION

Circle the correct rating for each line entry.

	(a) High	(b) Moderate	(c) Low
BOATING: (Pleasure and Fishing - canoe and flat bottom)			
1. Principal Wetland Type used for boating (4 or 5)	5	4	All others
2. Acres available (per continuous wetland 4 & 5)	100+	>50 but <100	<50
3. Physical Access (No. of Access Points)	2+	1	0
4. Boatable Stream Present	(enters and leaves wetland)	(enters or leaves wetland)	none present
FISHING: (shoreline)			
5. Principal Wetland Type used for fishing (4 or 5)	5	4 (with some type 5 present)	other
6. Wetland Size (acres)	50+	>25 but <50	<25
7. Physical Access--shore Percent of shoreline from which fishing is available	20%+	5%+ but <20%	<5%
NATURE STUDY:			
8. Diversity of plants and animals (number of types)	3 or more	2	1
9. Percent of urban development within 300 feet of wetland perimeter.	<5%	5% to <25%	25%+
HUNTING:			
10. Waterfowl hunting - amount of Type 3, 4 and 5	100 acres+	25+ but <100	<25 acres
11. Access for hunting	Unlimited	Permission of landowner required	None available

Total number of items circled in (a) _____ (b) _______

Calculation:
No. circled in column (a) x 2 + no. circled in column (b) x 1 = __________

RATING: Total is: 16 to 22 = High
9 to 15 = Moderate
0 to 8 = Low

RATING IS: _______________

WETLAND EVALUATION

Wetland Name ______________________________ No. ____

UNIQUENESS

Circle the correct rating for each line entry.

	(a) High	(b) Moderate	(c) Low
1. Location - wetland surrounded by:	Intensely urban	Suburban	Rural
2. Wetland supports a threatened, endangered, or uncommon species of plant or animal	A threatened or endangered species	An uncommon species	None
3. Wetland contains a regionally rare plant community 1/	Yes	--	No
4. Wetland attracts a regionally significant number of migrating birds	Yes	--	No
5. Wetland is archaeologically, geologically or historically significant	Yes	--	No
6. Size: (acres)*	500 acres and more	200 acres or more but <than 500 acres	<200 acres

Total number of items circled in: (a) _____ (b) ______

Calculation:
No. circled in column (a) x 2 + no. circled in column (b) x 1 = __________

RATING: a. Any item 2-6 rating high = High
b. Total is: 3 to 6 = Moderate
0 to 3 = Low

RATING IS: _________

1/ Occurs less than 5% of the time in inventoried wetlands.

* Uniqueness due to size may need evaluation by region in Massachusetts. The north and southeastern sections of the state have wetland areas qualifying (under for the above categorization; Western and Central Massachusetts should be re-evaluated in terms of overall wetland size.

WETLAND EVALUATION

Wetland Name ____ No. ________

VISUAL QUALITY

Circle the correct rating for each line entry.

	(a) High	(b) Moderate	(c) Low
1. One or more public roads enables travelers to overlook the wetland at	3+ different locations or 1 mile or more	2 different locations or 1/4 mile+ but <1 mile	1 location or <1/4 mile
2. Overlooks accessible by-path or trail	2 or more overlooks accessible	1 overlook accessible	No overlooks accessible
3. Wetland contains some type 7 wetland consisting of deciduous woodland	75+ acres of red maple	40+ but <75 of red maple	<40 acres
4. Surrounding topography provides potential for developing overlooks	Potential for 2 or more different overlooks	Potential for 1 overlook	No potential for an overlook
5. Wetland contains an island	Yes	---	No
6. Appearance and condition	Undisturbed an natural	Somewhat disturbed and littered	Messy, littered filling, junky
7. Wetland types	Wetland contains some visible Type 4 or 5	Wetland contains some Type 2 or 3	Wetland contains no visible Types 2, 3, 4 or 5

Total number of items circled in (a) ______ (b) ______

Calculation:
No. circled in column (a) x 2 + no. circled in column (b) x 1 = __________

RATING: Total is: 10 to 14 = High
5 to 9 = Moderate
0 to 4 = Low RATING IS: __________

CRITERION 1 - PUBLIC OWNERSHIP

Publicly owned forest land is more prone to multiple use management which includes wood fiber production as one of the uses.

CRITERION 2 - STAND SIZE CLASS DISTRIBUTION

The optimum size class distribution is 50 percent sawtimber, 25 percent poletimber and 35 percent seedling-sapling. Sawtimber trees are live trees of commercial species that have the following minimum diameters at breast height--softwoods 9.0 inches and hardwoods 11.0 inches. Poletimber trees are live trees of commercial species at least 5.0 inches in diameter at breast height but smaller than sawtimber size. Seedling-sapling trees are live trees of commercial species with diameters at breast height of less than 5.0 inches.

CRITERION 3 - STAND DENSITY

Optimum wood fiber production is achieved when the stand is fully stocked. One measure of stocking is the amount of crown closure. The greater portion of the forest that is at or near full stocking, the higher the potential for wood fiber production.

CRITERION 4 - PORTION OF WETLAND FORESTED

The greater the amount of the wetland forested, the greater the potential for wood fiber production, and the greater the incentive for the landowner to manage the land for forest products.

CRITERION 5 - FOREST COVER TYPE

The forest cover type of any area is determined by the principal species present. Cedar, red maple, larch/tamarack, or green ash are the cover types that have the highest value for wood fiber production. Management of these types would be the most profitable.

CRITERION 6 - SHAPE OF FORESTED WETLAND

A block of forest land of some regular shape is more conducive to management than a long narrow strip of forestland, as might be found along a waterway.

CRITERION 7 - TYPE OF SOIL

The volume of wood that can be grown on a site is directly related to the soil. Peat soils generally produce wood fiber at a much slower rate and poorer quality than mineral soils.

CRITERION 8 - ACCESSIBILITY

Forest land that has roads to and through it is more conducive to management because road construction is one of the major expenses of forest management.

Rationale - Flood Control

To evaluate wetlands for their value in flood control three basic factors are considered, these are: (1) the actual storage, (2) the effectiveness of that storage, (3) the existing need for control downstream (damage potential).

1. The effective storage of a wetland in relation to its drainage area is the single most important factor in flood control. As the inches of runoff storage increases, the more significantly are flows extended over a longer period of time, thus reducing the peak flows from any given storm.

2. Effective upstream storage by reservoirs and other wetlands may already be controlling the flows to the extent that the storage in question may have little effect, even though it has a very effective storage volume.

3. Main stem storage upstream of a potential damage area can have the same effect on peak flows as another wetland. Also, small streams entering a large stream generally have a significantly reduced effect on flows below that point.

4. The effect of a wetland decreases as you move downstream from it. This is because of two things, first, the routing effect of the stream channel and flood plain itself and secondly, as you move downstream, the drainage area becomes progressively larger and the considered wetland has less effect.

5. The value or importance of a wetland for flood control is reduced if there is little or no potential for damage downstream regardless of how effective it may be.

Rationale - Fish Habitat

Principal Wetland Type - Type 5 is the only freshwater wetland type that can support fish in all seasons. Type 4 is suitable in spring and fall, but some Type 5 must be present to maintain fish during summer and winter.

Size - The larger the wetland, the more fish it will physically support. One hundred acres was considered necessary to rate high in a regionwide inventory.

Location of Wetland - Wetlands are often used for spawning habitat by warm water species of fish. Some species of fish (e.g., golden shiner, chain pickerel) require aquatic vegetation for spawning sites. Warm water lake fishery is dependent on wetland acreage for spawning sites, nutrient inflow, and as young fish rearing areas. Perennial streams supporting warm water fish benefit from wetlands, but generally less so than lakes. Intermittent streams do not support substantial fishery.

Presence of Fish Cover - Warm-water fish require logs, stumps, pond lilies, watershield, etc. for protective cover. If the wetland surface is covered with 35 percent or more with stumps, lilies and other plants, it will have a rating of abundant; 10 percent or more, but less than 35 percent will rate as moderate; less than 10 percent as scarce.

Presence of Game Fish - If the wetland is included in "An Inventory of the Ponds, Lakes and Reservoirs of Massachusetts" by James A. McCann (published by Water Resources Research Center, University of Massachusetts) and has a specified productivity of 60 or more pounds of fish per acre, the rating will be high. If listed productivity is 40 or more, but less than 60, the rating will be moderate. If listed productivity is less than 40 pounds per acre, the rating will be low.

If the wetland is not included in "An Inventory of the Ponds, Lakes, and Reservoirs of Massachusetts," then the rating will be based on the following:

High rating - 2 or more species of game fish are present
Moderate rating - 1 species of game fish is present
Low rating - no species of game fish is present.

Game fish shall be limited to brook trout, brown trout, largemouth bass, chain pickerel, and northern pike.

Rationale - Wetland Wildlife Habitat

These criteria were developed to rate wetlands for wetland wildlife habitat. Species in this category include shorebirds, waterfowl, herons, bittern, beaver, muskrat, otter, and associated songbirds (e.g., yellow warbler, tree swallow, red-winged blackbird, marsh wren, kingfisher, etc.).

Principal Wetland Type - For wetland wildlife Types 3 and 4 1/ were considered the most valuable. In the northeast 3/4 or more of the Type 3 and 4 wetlands are classified of prime importance to waterfowl. These types are also of high value to the other forms of wetland wildlife itemized above. Types 5, 6 and 7, although not providing as great a diversity of plant life, are of moderate value to wetland wildlife.

Types 1, 2 and 8 are either only infrequently wet or support a very limited diversity of plants (bogs).

Although all wetland types provide habitat for certain species of wildlife, the criteria emphasizes those types with permanent water for the wetland wildlife rating.

1/ Wetlands of the United States, Circular 39, U.S. Department of the Interior, 1971.

Number of Wetland Types - The greater the number of types in a single wetland the greater will be the diversity of flora and fauna in that wetland. Diversity is a common parameter for measuring quality.

Diversity of Adjacent Land Use - Adjacent land uses provide additional feeding or nesting sites for many of the wetland wildlife species.

Buffer Strip - A 300 foot wide or greater buffer strip without occupied buildings or other intensive uses will serve to protect the amenities of the wetland. Buffer strips provide nesting habitat for many species of wetland wildlife. Seventy-five percent of all duck nests are found within 300 feet of water. Nests are seldom found closer than 100 feet of buildings.

Size - A minimum wetland size was necessary to prevent excessive expenditures of time on the wetland inventory portion of the river basin studies. The minimum size varies in different regions of the state depending upon the number and size of wetlands present. It is the intent of the inventory to include only the more significant wetlands in each region, however, smaller wetlands of regional significance may be included.

Islands - Islands provide a preferred nesting site of the mallard, teal and black duck. Islands offer natural protection from predators reluctant to travel over water to reach the island.

Islands also usually provide a diverse vegetative condition especially when the island elevation exceeds 3 feet above the normal water elevation of the wetland.

Rationale - Recreation

These criteria were developed to rate the value of a wetland for canoe or flat bottom boating, fishing, nature study and hunting. These were considered to be the primary recreation activities conducted on wetlands.

Boating

Principal Wetland Type - Type 5 (inland open Freshwater) consists of open water up to 10 feet deep and because it is deep was rated the best suited for boating use.

Type 4 was rated as moderate value for boating because its depth ranges from only 6 inches to 3 feet and it supports a substantial amount of emergent and floating aquatic plant growth.

All other wetland types were considered unsuitable for boating because of: lack of standing water or dense vegetation.

Acres Available - The more boatable water available, the more desirable the boating activity. Continuous wetland means that the wetland inventoried is either one single wetland or is two or more boatable wetlands linked by a boatable stream.

Physical Access - Physical access means that it is convenient to launch a canoe or flat bottom boat without excessive carrying distances or without having to push the craft out through dense woody vegetation to reach open water.

Boatable Stream Present - Access is facilitated and it is more desirable if a boatable stream enters, crosses and leaves a wetland area.

Fishing

Principal Wetland Type - Type 5 is the only wetland type of sufficient depth to support fish during all seasons. Type 4 will support fish in spring and fall but there is likely to be oxygen deficiencies in summer and winter, therefore, the presence of some Type 5 is essential.

Size - The larger the wetland the more attractive it is for fishing and the more fish will be supported. One hundred acres or more in size was considered necessary to rate high in a regionwide inventory.

Physical Access - Shore - Many persons, particularly children desiring to fish do not have boat equipment and their fishing is limited to the shoreline. Some open shoreline free of woody plants and dense herbaceous plants is necessary for casting.

Nature Study

Diversity of Plants and Animals - Each wetland type supports a variety of wetland flora and fauna. The greater the number of wetland types present in the wetland the greater will be the diversity of flora and fauna. The more diversity present the better will be the nature study opportunities.

Wetland Perimeter - Urban development in the 300 foot wide strip would detract from the nature study values of a wetland (noise, pollutants, litter, domestic animals, trail bikes, etc.).

Hunting

Waterfowl Hunting - Types 3, 4 and 5 are the most attractive wetlands for waterfowl and consequently for waterfowl hunting. Although any size wetlands of these types will attract waterfowl, a 100 acre plus wetland was considered to be significant on a regionwide basis.

Access for Hunting - Hunting is only possible where permitted by the landowner or governing agent.

Rationale - Uniqueness

Location of Wetland - There are few situations where wetlands are located in intensely urbanized areas. Where this is the case, the wetland provides many people with the opportunity to observe or study the diverse flora and fauna within the wetland. Close proximimity to schools offers the potential for formal study by school biology and earth science classes.

Threatened, Endangered or Uncommon Species - Science is as yet ignorant of the net results of a species being exterminated and until mankind becomes this sophisticated in his knowledge of the natural environment we had best tread lightly. The diversity of species is an indicator of environmental quality and when the diversity is reduced the environmental quality is likewise reduced. Man is a part of the natural environment and must co-exist with other species in this natural environment.

Migrating Birds - Offers the public an opportunity to see unusual wildlife concentrations.

Archaeologic, Geologic or Historic Significance - This determination will be sought from local, regional and state authorities (e.g. State Historical Society, Regional Planning Authority).

Size - Any wetland greater than 200 acres in size is uncommon in the Commonwealth of Massachusetts.

Rationale - Visual Quality

The visual quality of a wetland is largely dependent upon the wetland's openness and available access from which people can view it. Wetland Types 1/ 2, 3, 4, and 5 are the more open types which people can look at.

Roads around or through a wetland enable people to look out over the wetland even though they don't care to walk into its interior. For those persons wanting to see a wetland, paths or trails facilitate access.

Islands add to the diversity of flora within a wetland and, therefore, contribute to the wetland's visual quality.

Litter detracts from a wetland's appearance and, therefore, absence of litter is a positive factor.

1/ Wetland type pertains to those described in Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service, United States Government Printing Office, Washington, D.C., 1971.

APPENDIX C

Public Lakes, Ponds and Reservoirs

Prepared by the Massachusetts Division of Water Resources

The purpose of this phase of the study is to compile a comprehensive listing of public ponds, lakes and reservoirs relative to size, access, flowage rights and ownership, as well as water and shoreline use. The Massachusetts Water Resources Study principals have come to realize that the ownership of our water resources is a question of paramount importance to the public.

Current information on water body status as a public or private resource is often incomplete, inaccurate or out-of-date. Within the framework of this study, the Massachusetts Division of Water Resources found the appropriate opportunity to gather some new information. It is planned that this survey will be continued eventually to cover the entire state and made part of a permanent record system.

At the study's outset, available existing information was used heavily to produce a rough, preliminary working list. Sources used included Department of Public Works (DPW) and Department of Environmental Quality Engineering (DEQE) records, the University of Massachusetts County Lakes, Ponds and Reservoirs Inventories by McCann, et al., in addition to earlier studies conducted by the Division of Fisheries and Wildlife. These sources produced an extensive working list refined according to certain criteria to establish eligibility for the final listings.

A primary objective of this survey is to identify water bodies which should be available for public use. It was found that certain waters could be eliminated quickly. Except for municipally-owned reservoirs over 20 acres with recreational access, and water bodies within state or federally-owned land, natural ponds under 10 acres and wholly man-made reservoirs were excluded. As a result of applying these criteria, only ponds, lakes and reservoirs of apparent public status and significance remain on this final listing for the Connecticut River Region.

It should be noted that the designation of "apparent public or great pond status" does not preclude the occurrence of private ownership of some of the water bodies so labeled. However, this classification should signal the need for a full survey pursuant to Chapter 91 or 131 of the General Laws to clear up any remaining question of status on water bodies within this category. When a pond's public status has been ascertained, access can be provided by the Massachusetts Public Access Board acting pursuant to the authority contained in Section 17 of Chapter 21 of the Massachusetts General Laws.

Basic Facts Regarding Great Ponds as Provided by the Colony Ordinance of 1641-7 and Its Interpretations

Size
Great Ponds are those over 10 acres, except regarding fishing where rights exist in ponds over 20 acres.

Ownership
Pond bottom is owned by the state below the ordinary low water mark.

Rights
Use by the public, so long as one does not trespass on a man's "corn or meadow." A right also exists to seek the provision of a public access to avoid such trespass.

Uses
Fishing, fowling, boating, bathing, skating or riding upon the ice, taking of water for domestic or agricultural purposes, or for use in the arts and the cutting and taking of ice.

Enlarged Great Ponds
Public rights exist in the entire waters of an enlarged natural great pond. In discussing this, Massachusetts Water Laws (1970) states:

> "A reflection upon all of the cases which have been reviewed seems to establish conclusively that all public rights in natural great ponds...can be lawfully exercised in any part of the waters which are impounded by dams erected at the outlet of great ponds containing more than 10 acres, except the public right of fishing, which right will be restricted to natural great ponds exceeding 20 acres in size."

By checking records of the county engineer and by comparing the heights of dams with depth data, many enlarged great ponds can be identified. Even with such research and onsite inspections, some water bodies could not definitely be assumed to be great ponds. Formal surveys by the Waterways Division could ascertain their status.

It should be noted that this list is not, therefore, official. It represents our best judgment, bearing in mind that exact measurements are required in borderline cases. The problem of great pond identification is most difficult where an original natural pond has been enlarged by the construction of a dam at its outlet.

The significance of the study is manyfold. It indicates those ponds where the right of public access exists and can be developed under existing law.[1/] It also suggests that other lakes not listed are currently private. Where important private water bodies exist, public funds might be expended to obtain usage rights where appropriate.

1/ Caveat--No right exists to walk along privately-owned shorelines once access is obtained. Public access rights may also be denied by the local water authority where a pond is withdrawn for water supply. Uses may be regulated by towns and state agencies, as authorized by statute.

CONNECTICUT RIVER REGION
Massachusetts Water Resources Study
Index of Towns Selected to Represent Each Study Area

CENTRAL CONNECTICUT VALLEY STUDY AREA

Amherst	Northampton
Chicopee	Pelham
Deerfield	Shutesbury
Easthampton	South Hadley
Granby	Southampton
Hadley	Sunderland
Hatfield	Westhampton
Holyoke	Whately
Leverett	Williamsburg
Montague	

CHICOPEE STUDY AREA

Barre	Oakham
Belchertown	Palmer
Brookfield	Paxton
East Brookfield	Petersham
Hardwick	Phillipston
Hubbardston	Rutland
Ludlow	Spencer
Monson	Ware
New Braintree	Warren
New Salem	West Brookfield
North Brookfield	

DEERFIELD STUDY AREA

Ashfield	Hawley
Buckland	Heath
Charlemont	Leyden
Colrain	Monroe
Conway	Rowe
Florida	Savoy
Greenfield	Shelburne

FARMINGTON STUDY AREA

Granville	Sandisfield
Otis	Tolland

MILLERS STUDY AREA

Ashburnham	Royalston
Athol	Templeton
Erving	Warwick
Gardner	Wendell
Orange	Winchendon

NORTHERN CONNECTICUT VALLEY STUDY AREA

Bernardston	Northfield
Gill	

SOUTHERN CONNECTICUT VALLEY STUDY AREA

Agawam	Longmeadow
East Longmeadow	Springfield
Hampden	Wilbraham

WESTFIELD STUDY AREA

Becket	Peru
Blandford	Plainfield
Chester	Russell
Chesterfield	Southwick
Cummington	Westfield
Goshen	West Springfield
Huntington	Windsor
Middlefield	Worthington
Montgomery	

CENTRAL CONNECTICUT VALLEY STUDY
AREA COMMUNITIES

1. Amherst

College Pond #2-8-8-1 (CV-19) 2 Acres

This small artificial pond on the campus of the University of Massachusetts, at Amherst, provides winter ice skating. Informal public access can be obtained across the university campus. The dam is controlled by the university.

2. Chicopee

Wade Pond #2-7-61-9 (CV-26) 22 Acres

(See Wade Pond, Ludlow)

Chicopee Reservoir #2-7-61-3 (CP-35) 30 Acres

This artificial impoundment is within the Chicopee State Park under the administration of the Massachusetts Division of Forests and Parks, Department of Environmental Management (DEM). Informal public access is available across the state land. A beach has been developed and the reservoir is presently stocked for shore fishing by the Massachusetts Division of Fisheries and Wildlife. Flowage rights are with the state.

3. Deerfield

No lakes, ponds, or reservoirs that meet the study criteria.

4. Easthampton

Nashawannock Pond #2-8-87-7 (CV-23) 37 Acres

Informal public access can presently be gained across town-owned parkland to this municipally-owned, artificial pond. A small beach has been developed. The dam is owned by the Town of Easthampton, with some water rights with the Stevens Company.

5. Granby

Forge Pond #2-8-111-2 (CV-25) 72 Acres

This is a municipally-owned artificial pond. Flowage is with the Town of Granby, Conservation Commission. No public recreational use is presently allowed.

6. Hadley

No lakes, ponds, or reservoirs that meet the study criteria.

7. Hatfield

Great Pond North (CV-17) 11 Acres

This apparent natural great pond in the so-called "Hatfield Oxbow" has no formal public access.

Great Pond South (CV-17) 10 Acres

This apparent natural great pond in the so-called "Hatfield Oxbow" has no formal public access.

Mountain Street Reservoir #2-8-340-6 (CV-22) 67 Acres

(See Mountain Street Reservoir, Williamsburg)

8. Holyoke

Ashley Pond #2-7-137-9 (WE-46) 288 Acres

Ashley Pond (includes Cedar and Wrights Ponds and Connor Reservoir) is an artificial impoundment that serves as water supply for the City of Holyoke and the Town of Southampton. The dam is owned by the City of Holyoke, and the pond is closed to public recreational use.

McLean Reservoir #2-7-137-7 (WE-46) 65 Acres

Flowage is with the City of Holyoke Waterworks on this artificial impoundment used as water supply by the City of Holyoke. The reservoir is closed to recreational use.

Whiting Street Reservoir #2-7-137-4 (CV-26) 121 Acres

This artificial reservoir serves as part of the water supply for the City of Holyoke, the owner of the dam. The reservoir is closed to recreational use.

9. Leverett

Leverett Pond #2-6-154-1 (CV-19) 68 Acres

This is an apparent enlarged great pond for which no public access has been provided. The dam is owned by Lucille Lewis of Wendell.

10. Montague

Green Pond (CV-18) 12 Acres

This apparent natural great pond is withdrawn for water supply by the Town of Montague and the village of Turners Falls. The pond is closed to recreational use.

Lake Pleasant #2-6-192-1 (CV-18) 50 Acres

Flowage is with the Turners Falls Fire District Water Department on this enlarged apparent great pond that has been withdrawn for water supply by the Town of Montague and the village of Turners Falls. The pond is presently closed to any recreational use.

11. Northampton

Oxbow Lake (CV-22) 166 Acres

This natural oxbow lake, part of the Connecticut River, has a public boating access ramp developed by the Massachusetts Public Access Board.

Oxbow Cutoff (CV-22) 50 Acres

This portion of the previously described Oxbow Lake, part of the Connecticut River, has informal public access from state Route #5.

Roberts Meadow Reservoir #2-8-214-14 (CV-22) 25 Acres

There is no access for public recreational use to this municipally-owned water supply reservoir. The City of Northampton, Water Division owns the dam and flowage rights.

Rocky Hill Pond #2-8-214-2 (CV-22) 3 Acres

This small artificial pond is within the Northampton State Hospital grounds, under the administration of the Executive Office of Human Services. Flowage rights are with this office. The pond is presently kept drained because of needed dam repairs.

12. Pelham

No lakes, ponds, or reservoirs that meet the study criteria.

13. Shutesbury

Atkins Reservoir #2-6-272-1 (CV-19) 59 Acres

This is an apparent enlarged great pond withdrawn for water supply for the Town of Amherst. Flowage rights are with the Town of Amherst Water Division. The reservoir is closed to recreation.

Lake Wyola #2-6-272-2 (CV-18) 129 Acres

The dam is owned by the Town of Shutesbury, Park Department on this enlarged natural great pond identified by the Massachusetts Division of Waterways (DEQE). A town-owned beach and boat ramp have been developed. At present, there is informal public access across this town land. The lake is stocked by the Massachusetts Division of Fisheries and Wildlife.

Quabbin Reservoir #2-8-309-1A, B, C (CP-27) 24,700 Acres

(See Quabbin Reservoir, Petersham)

14. South Hadley

No lakes, ponds, or reservoirs that meet the study criteria.

15. Southampton

Pequot Pond (WE-44) 154 Acres

(See Pequot Pond, Westfield)

Tighe Carmody Reservoir #2-8-276-4 (CV-24) 365 Acres

The dam and flowage rights are owned by the City of Holyoke, Waterworks on this artificial impoundment, part of the city water supply. It is closed to public use.

White Reservoir #2-8-276-5 (CV-24) 132 Acres

(See White Reservoir, Northampton)

16. Sunderland

Cranberry Lake #2-6-289-2 (CV-17) 25 Acres

Flowage rights are with the University of Massachusetts, Forestry Department on this enlarged apparent great pond within the Mount Toby State Forest administered by UMass Forestry Department. A small boat launch has been developed. The pond is stocked with fish by the Massachusetts Division of Fisheries and Wildlife (DFW & RV). Informal public access is available across this state land.

17. Westhampton

White Reservoir #2-8-276-5 (CV-24) 132 Acres

This is an artificial impoundment used as water supply by the City of Holyoke, Waterworks, the owner of the flowage rights. It is closed to public use.

18. Whately

Mountain Street Reservoir #2-8-340-6 (CV-22) 67 Acres

(See Mountain Street Reservoir, Williamsburg)

Northampton Reservoir #2-6-337-3 (CV-20) 82 Acres

This artificial water supply reservoir, part of the Northampton city water supply, is closed to recreational use. The city owns the dam and flowage rights.

19. Williamsburg

Mountain Street Reservoir #2-8-340-6 (CV-22) 67 Acres

This artificial reservoir serves as part of the water supply for the City of Northampton. The dam and flowage rights are owned by the city. No recreational use of the reservoir is presently allowed.

CHICOPEE STUDY AREA COMMUNITIES

1. Barre

   No lakes, ponds, or reservoirs that meet study criteria.

2. Belchertown

Arcadia Lake (Middle Metacomet Pond)		(CV-25)	40 Acres

   This is an apparent natural great pond with no formal public access.

Knights Pond	#2-8-24-11	(CP-28)	34 Acres

   The City of Springfield owns this artificial water supply reservoir. The dam and flowage rights are also controlled by Springfield. No public access is permitted.

Lake Holland (Metacomet Upper Pond)		(CV-25)	12 Acres

   No formal public access is available to the waters of this apparent natural great pond.

Metacomet Lake (Metacomet Lower Pond)		(CV-25)	74 Acres

   This is a natural great pond identified by the Division of Waterways, (DEQE). Formal public access has been established by Hampshire County. The pond is stocked by the Division of Fisheries and Wildlife.

Quabbin Reservoir	#2-8-309-1A, 1B, 1C	(CP-27)	24,700 Acres

   (See Quabbin Reservoir, Petersham)

3. Brookfield

Quaboag Pond (Podunk Pond)		(CP-32)	541 Acres

   Here is a natural great pond surveyed by the Division of Waterways, (DEQE). Formal public access has been developed by the Massachusetts Public Access Board.

Quacumquasit Pond (South Pond)		(CP-32)	226 Acres

   This is another natural great pond surveyed by the Massachusetts Division of Waterways, (DEQE). At present, informal public access is available over a town-owned boat ramp. Also, the pond can be reached from adjacent Quaboag Pond. It is stocked for fishing by the Massachusetts Division of Fisheries and Wildlife.

4. East Brookfield

Lake Lashaway #3-14-84-2 (CP-32) 293 Acres

(See Lake Lashaway, North Brookfield)

Mud Pond (CP-32) 10 Acres

There is no formal public access to this apparent natural great pond.

Quaboag Pond (Pondunk Pond) (CP-32) 541 Acres

(See Quaboag Pond, Brookfield)

Quacumquasit Pond (South Pond) (CP-32) 226 Acres

(See Quacumquasit Pond, Brookfield)

5. Hardwick

Hardwick Pond (Muddy Pond) #2-8-309-17 (CP-31) 68 Acres

This enlarged great pond identified by the Division of Waterways, (DEQE) is used for water supply. The Town of Ware controls the dam and flowage rights. Formal public access has been developed by Worcester County and also by the Massachusetts Public Access Board. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife.

Quabbin Reservoir #2-8-309-1A, 1B, 1C (CP-27) 24,700 Acres

(See Quabbin Reservoir, Petersham)

6. Hubbardston

Asnacomet Pond (Comet Pond) #3-14-140-24 (CP-29) 127 Acres

The MDC, Water Division owns the dam and flowage rights of this apparent enlarged great pond. Formal public access has been developed by the Massachusetts Public Access Board. It is stocked by the Massachusetts Division of Fisheries and Wildlife.

Bickford Pond #3-14-140-32, 32.1 (CP-29) 150 Acres
(Ropers Reservoir)

The City of Fitchburg owns this artificial water supply reservoir. The dam and flowage rights are controlled by the city. No public access is permitted.

6. Hubbardston (continued)

Brigham Pond #3-14-140-4 (CP-29) 45 Acres

This is a publicly-owned artificial pond. The MDC, Water Division apparently owns the dam and flowage rights. Informal access for boating and fishing is available across MDC land.

Chandler Pond #3-14-140-7.1 (CP-29) 4 Acres

This small artificial pond has been leased by the MDC to the Massachusetts Division of Fisheries and Wildlife. Informal access is available to the pond across MDC land in the Hubbardston Wildlife Management Area, administered by the Massachusetts Division of Fisheries and Wildlife. The MDC, Water Division owns the dam and flowage rights. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife.

Cunningham Pond #3-14-140-7 (CP-29) 28 Acres

The Massachusetts Division of Fisheries and Wildlife has leased this artificial pond owned by the MDC. It is located in the Hubbardston Wildlife Management Area with informal access for boating and fishing across MDC land. The dam and flowage rights are with the MDC, Water Division.

Mare Meadow Reservoir #3-14-140-25 (CP-29) 270 Acres

This is an artificial municipal water supply reservoir. The City of Fitchburg controls the dam and flowage rights. Informal access can be gained across this municipal land for shore fishing.

Moosehorn Pond #3-14-140-11 (CP-29) 62 Acres

This is an apparent enlarged great pond located within the MDC's Ware River Watershed. Informal access is available across MDC land within the Hubbardston Wildlife Management Area, administered by the Massachusetts Division of Fisheries and Wildlife. The dam and flowage rights are owned by the MDC, Water Division.

7. Ludlow

Chapin Pond (Haviland Pond) (CP-35) 25 Acres

This is a natural great pond identified by the Division of Waterways, (DEQE). Formal public access has been obtained by Hampden County subject to approval by the Division of Waterways (DEQE). The pond is stocked for fishing by the Massachusetts Division of Fisheries and Wildlife.

Minechaug Pond (Millers Pond) (CP-35) 21 Acres

This natural great pond identified by the Division of Waterways, (DEQE) has no formal public access.

Springfield Reservoir #2-7-161-6, 6A (CP-28) 448 Acres
(Ludlow Reservoir)

The City of Springfield owns this artificial water supply reservoir, controlling the dam and flowage rights. No public access is permitted.

Wade Pond #2-7-61-9 (CV-26) 22 Acres

This is a municpally-owned artificial pond with no present public access. The dam and flowage rights are owned by the Town of Ludlow. It is located on land formerly part of Westover Air Force Base.

8. Monson

Dean Pond #3-7-43-7 (CP-33) 10 Acres

This artificial pond is located in the Brimfield State Forest administered by the Department of Environmental Management, Division of Forests and Parks. The dam is owned by DEM. The pond is used for recreation. A swimming beach has been developed. Informal public access is available across the state land, and the pond is stocked by the Massachusetts Division of Fisheries and Wildlife (MDFW).

9. New Braintree

Brooks Pond #3-14-212-5 (CP-32) 185 Acres

(See Brooks Pond, North Brookfield)

10. New Salem

Bassett Pond (MI-4) 30 Acres

This is an apparent natural great pond located in the Quabbin Reservation, administered by the MDC. Informal access for shore fishing is available across the Reservation land.

North Spectacle Pond (Upper Spectacle Pond) (MI-4) 46 Acres

This apparent natural great pond has no formal public access.

South Spectacle Pond (Lower Spectacle Pond) (MI-4) 37 Acres

MDC land surrounds this apparent natural great pond as part of the Quabbin Reservation. Informal public access for shore fishing is allowed.

Quabbin Reservoir #2-8-309-1A, 1B, 1C (CP-27) 24,700 Acres

(See Quabbin Reservoir, Petersham)

11. North Brookfield

Brooks Pond (Sapphire Pond) #3-14-212-5 (CP-32) 185 Acres

The Daniels Manufacturing Company owns the dam and flowage rights for this apparent enlarged great pond. No formal public access has been established.

Doane Pond #3-14-212-1 (CP-32) 30 Acres

This is a municipally-owned, artificial reservoir used for water supply by the Town of North Brookfield. The dam and flowage rights are owned by the town. Recreation use is limited to shore fishing for town residents. There is no formal public access.

Horse Pond #3-14-212-2 (CP-32) 61 Acres

The Town of North Brookfield has withdrawn this apparent enlarged great pond for water supply. The dam and flowage rights are owned by the town. Recreation use is limited to shore fishing for town residents. There is no formal public access.

11. North Brookfield (continued)

Horse Pond Dam #3-14-212-8 (CP-32) 10 Acres

This artificial reservoir was constructed under the Watershed Protection and Flood Prevention Act (PL-566). The project, a cooperative effort of federal, state, and town interests, provides flood control, fish and wildlife enhancement, and flow augmentation benefits. Flowage rights are with the Massachusetts Water Resources Commission, the owner of the dam. Informal access is available to the public across this Commission land.

Kittredge Pond Dam #3-14-212-9 (CP-32) 7 Acres

This artificial reservoir was constructed under the Watershed Protection and Flood Prevention Act (PL-566). The project, a cooperative effort of federal, state, and town interests provides flood control, fish and wildlife enhancement, and flow augmentation benefits. Flowage rights are with the Massachusetts Water Resources Commission, the owner of the dam. Informal access is available to the public across this Commission land.

Lake Lashaway (Furnace Pond) #3-14-84-2 (CP-32) 293 Acres

This is an apparent enlarged great pond with no formal public access. The Town of East Brookfield owns the dam and flowage rights.

Perry Pond (CP-32) 12 Acres

There is no formal public access to this apparent natural great pond.

12. Oakham

Brooks Pond #3-14-212-5 (CP-32) 185 Acres

(See Brooks Pond, North Brookfield)

Browning Pond #3-14-280-6 (CP-32) 100 Acres

This is an apparent enlarged great pond with no formal public access. The Mann-Stevens Wool Company owns the dam and flowage rights.

Foley Pond #3-14-222-13 (CP-32) 6 Acres

The Department of Environmental Management owns this small artificial pond. It is located in Oakham State Forest which is administered by the Division of Forests and Parks. Informal access for shore fishing is available across state park land.

12. Oakham (continued)

Muddy Pond #3-14-222-5 (CP-29) 25 Acres

This apparent enlarged great pond is located in the MDC's Ware River Watershed. The dam and flowage rights are controlled by the MDC, Water Division. Informal access for recreation is available across MDC land.

13. Palmer

Crystal Lake (CP-28) 16 Acres

Here is an apparent natural great pond with no formal public access.

Forest Lake #3-7-227-10 (CP-31) 50 Acres

This is an enlarged great pond identified by the Division of Waterways (DEQE). The Forest Lake Park Company owns the dam and flowage rights. No formal public access has been developed. The pond is stocked by the Division of Fisheries and Wildlife.

Pattaquattic Pond (Round Pond) (CP-31) 18 Acres

A natural great pond identified by the Division of Waterways, (DEQE) with no formal public access.

14. Paxton

Asnebumskit Pond #3-14-228-7 (NA-5) 34 Acres

The Town of Paxton has withdrawn this apparent enlarged great pond for water supply. No public access is permitted.

Eames Pond #3-14-228-3 (CP-32) 55 Acres

This is a publicly-owned artificial pond located in Moore State Park administered by the Division of Forests and Parks, (DEM). Informal access for shore fishing is available across state park land.

Pine Hill Reservoir #3-14-134-6 (NA-5) 345 Acres

The City of Worcester owns this artificial water supply reservoir. The dam and flowage rights are owned by the city. No formal public access is permitted.

Reservoir #3 (Kettle Brook Reservoir #3) #3-14-151-24 (BL-61) 37 Acres

This artificial water supply reservoir is owned by the City of Worcester. No formal public access is permitted.

14. Paxton (continued)

Reservoir #4 (Kettle Brook Reservoir) #3-14-228-5 (BL-61) 119 Acres

No formal public access is permitted to this artificial water supply reservoir. The City of Worcester owns the dam and flowage rights.

15. Petersham

Turkey Hill Pond (CP-32) 90 Acres

(See Turkey Hill Pond, Rutland)

Quabbin Reservoir #2-8-309-1A,1B,1C (CP-27) 24,700 Acres

This artificial reservoir is within the Quabbin Reservation administered by the Metropolitan District Commission (MDC). It serves as water supply for the Metropolitan Boston area. Informal public access for recreation is available across this state-owned land. Three (3) boat ramps have been developed. Fishing from non-power or motor boats of limited horsepower is permitted. Flowage rights are with the MDC. The lake is stocked for fishing by the Massachusetts Division of Fisheries and Wildlife.

Riceville Pond #3-14-15-51 (MI-4) 71 Acres

This is a publicly-owned artificial pond located in Petersham State Forest. The dam is owned by the Department of Environmental Management, Division of Forests and Parks. Informal access for shore fishing is available across state park land.

16. Phillipston

Phillipston Reservoir #3-14-235-1 (MI-2) 22 Acres

The Town of Athol owns this artificial water supply reservoir. The dam and flowage rights are controlled by Athol. No public access is permitted.

Queen Lake #3-14-235-13 (CP-29) 137 Acres

This is an enlarged great pond identified by the Division of Waterways (DEQE). The Town of Phillipston owns the dam and flowage rights. No formal public access has been established.

Reservoir #2 #3-14-15-50, 50A (MI-4) 50 Acres

This is a municipally-owned artificial reservoir used for water supply by the Town of Athol. The dam and flowage rights are controlled by Athol. Public access for recreation is restricted.

17. Rutland

Demond Pond #3-14-257-6 (CP-29) 119 Acres

The MDC controls the land around this apparent enlarged great pond as part of the Ware River Watershed. The dam and flowage rights are owned by the MDC, Water Division. Informal access for boating and fishing is available across MDC land, and the pond is stocked by the Massachusetts Division of Fisheries and Wildlife.

Long Pond #3-14-257-4,4.1 (CP-29) 144 Acres

This is an enlarged great pond surveyed by the Division of Waterways (DEQE). It is located within the Rutland State Park leased from the MDC by the Department of Environmental Management, and administered by the Division of Forests and Parks. The MDC, Water Division controls the dam and flowage rights. Informal public access for fishing and boating is available across this state land.

Muddy Pond #3-14-222-5 (CP-29) 25 Acres

(See Muddy Pond, Oakham)

Muchchopauge Pond #3-14-257-8 (NA-5) 68 Acres

The Towns of Holden and Rutland have withdrawn this apparent enlarged great pond for water supply. No public access is permitted.

Pine Hill Reservoir #3-14-134-6 (NA-5) 345 Acres

(See Pine Hill Reservoir, Paxton)

Turkey Hill Pond (CP-32) 90 Acres

This is an enlarged great pond identified by the Division of Waterways (DEQE). The dam and flowage rights are owned by Robert and Barbara Pierce. No formal public access has been established.

Whitehall Pond #3-14-257-4,4.1 (CP-29) 32 Acres

This enlarged great pond has been surveyed by the Massachusetts Division of Waterways (DEQE). The MDC, Water Division owns the dam and flowage rights. MDC has leased the land surrounding the pond to DEM's Division of Forests and Parks. The area is known as The Rutland State Park. Informal access for swimming and shore fishing is available across this state land. Fish are stocked by the Massachusetts Division of Fisheries and Wildlife.

18. <u>Spencer</u>

Brooks Pond (Sapphire Pond) #3-14-212-5 (CP-32) 185 Acres

(See Brooks Pond, North Brookfield)

Browning Pond #3-14-280-6 (CP-32) 100 Acres

(See Browning Pond, Oakham)

Cranberry Meadow Pond #3-14-280-25 (CP-32) 65 Acres

This is an <u>apparent enlarged great pond</u> with no formal public access. The dam and flowage rights are owned by the Town of Spencer.

Howe Pond #3-14-280-23,24 (CP-32) 14 Acres

The Department of Environmental Management, Division of Forests and Parks, owns this artificial pond which is located in Spencer State Forest. Informal public access is available for recreation.

Kittredge Dam Pond #3-14-212-9 (CP-32) 7 Acres

(See Kittredge Dam Pond, North Brookfield)

Sugden Reservoir #3-14-280-14 (CP-32) 85 Acres

This is a municipally-owned artificial reservoir with formal public access established by the Massachusetts Public Access Board from a boat ramp located in the Moose Hill Wildlife Management Area under the jurisdiction of the Division of Fisheries and Wildlife. The Town of Spencer owns the dam and flowage rights. Fish are stocked by the Massachusetts Division of Fisheries and Wildlife.

Thompsons Pond #3-14-280-13 (CP-32) 115 Acres

The Department of Environmental Management, Division of Forests and Parks owns this artificial pond, located in The Spencer State Forest. Adjacent land has been leased by DEM to the 4-H Club for recreational use. Informal access is available across this state forest land.

Lake Whittemore (Moose Pond) #3-14-280-21 (CP-32) 55 Acres

This is an <u>apparent enlarged great pond</u> with no formal public access. The dam and flowage rights are owned by the Town of Spencer.

17. Rutland

Demond Pond #3-14-257-6 (CP-29) 119 Acres

The MDC controls the land around this apparent enlarged great pond as part of the Ware River Watershed. The dam and flowage rights are owned by the MDC, Water Division. Informal access for boating and fishing is available across MDC land, and the pond is stocked by the Massachusetts Division of Fisheries and Wildlife.

Long Pond #3-14-257-4,4.1 (CP-29) 144 Acres

This is an enlarged great pond surveyed by the Division of Waterways (DEQE). It is located within the Rutland State Park leased from the MDC by the Department of Environmental Management, and administered by the Division of Forests and Parks. The MDC, Water Division controls the dam and flowage rights. Informal public access for fishing and boating is available across this state land.

Muddy Pond #3-14-222-5 (CP-29) 25 Acres

(See Muddy Pond, Oakham)

Muchchopauge Pond #3-14-257-8 (NA-5) 68 Acres

The Towns of Holden and Rutland have withdrawn this apparent enlarged great pond for water supply. No public access is permitted.

Pine Hill Reservoir #3-14-134-6 (NA-5) 345 Acres

(See Pine Hill Reservoir, Paxton)

Turkey Hill Pond (CP-32) 90 Acres

This is an enlarged great pond identified by the Division of Waterways (DEQE). The dam and flowage rights are owned by Robert and Barbara Pierce. No formal public access has been established.

Whitehall Pond #3-14-257-4,4.1 (CP-29) 32 Acres

This enlarged great pond has been surveyed by the Massachusetts Division of Waterways (DEQE). The MDC, Water Division owns the dam and flowage rights. MDC has leased the land surrounding the pond to DEM's Division of Forests and Parks. The area is known as The Rutland State Park. Informal access for swimming and shore fishing is available across this state land. Fish are stocked by the Massachusetts Division of Fisheries and Wildlife.

18. Spencer

Brooks Pond (Sapphire Pond) #3-14-212-5 (CP-32) 185 Acres

(See Brooks Pond, North Brookfield)

Browning Pond #3-14-280-6 (CP-32) 100 Acres

(See Browning Pond, Oakham)

Cranberry Meadow Pond #3-14-280-25 (CP-32) 65 Acres

This is an apparent enlarged great pond with no formal public access. The dam and flowage rights are owned by the Town of Spencer.

Howe Pond #3-14-280-23,24 (CP-32) 14 Acres

The Department of Environmental Management, Division of Forests and Parks, owns this artificial pond which is located in Spencer State Forest. Informal public access is available for recreation.

Kittredge Dam Pond #3-14-212-9 (CP-32) 7 Acres

(See Kittredge Dam Pond, North Brookfield)

Sugden Reservoir #3-14-280-14 (CP-32) 85 Acres

This is a municipally-owned artificial reservoir with formal public access established by the Massachusetts Public Access Board from a boat ramp located in the Moose Hill Wildlife Management Area under the jurisdiction of the Division of Fisheries and Wildlife. The Town of Spencer owns the dam and flowage rights. Fish are stocked by the Massachusetts Division of Fisheries and Wildlife.

Thompsons Pond #3-14-280-13 (CP-32) 115 Acres

The Department of Environmental Management, Division of Forests and Parks owns this artificial pond, located in The Spencer State Forest. Adjacent land has been leased by DEM to the 4-H Club for recreational use. Informal access is available across this state forest land.

Lake Whittemore (Moose Pond) #3-14-280-21 (CP-32) 55 Acres

This is an apparent enlarged great pond with no formal public access. The dam and flowage rights are owned by the Town of Spencer.

19. Ware

Pepper Mill Pond (Carters Pond) #2-8-309-2 (CP-31) 13 Acres

The MDC owns this small artificial pond which is located in the Quabbin Reservation. Informal access for shore fishing is permitted across Reservation land.

Quabbin Reservoir #2-8-309-1A,1B,1C (CP-27) 24,700 Acres

(See Quabbin Reservoir, Petersham)

Snow Pond #2-8-309-7 (CP-31) 25 Acres

This is a municipally-owned artificial pond used for recreation. The Town of Ware owns the dam and flowage rights. No public access is available.

20. Warren

Comins Pond #3-14-311-9 (CP-32) 24 Acres

The Warren Water District owns this artificial pond for recreation and use as emergency water supply. The dam and flowage rights are controlled by the District. No formal public access has been established.

21. West Brookfield

Wickaboag Pond #3-14-323-1 (CP-32) 320 Acres

This is an apparent enlarged great pond with no formal public access. The Town of West Brookfield owns the dam and flowage rights.

DEERFIELD STUDY AREA COMMUNITIES

1. Ashfield

   Ashfield Lake #2-6-13-1 (DE-16) 38 Acres

   This is an artificial, municipally-owned pond for which the Town of Ashfield has provided informal public access. Flowage is with the Town of Ashfield. A municipal beach and small boat landing have been developed.

2. Buckland

   No lakes, ponds, or reservoirs that meet the study criteria.

3. Charlemont

   No lakes, ponds, or reservoirs that meet the study criteria.

4. Colrain

   McLeod Pond - (DE-15) 40 Acres

   This apparent natural great pond is within the Catamount State Forest under the administration of DEM's Division of Forests and Parks. Informal access is available to the public across this state land. A small boat launch has been constructed.

5. Conway

   Conway Electric Lake #2-6-68-1 (DE-16) 13 Acres

   Contained in the South River State Forest, this public water is managed by the Massachusetts Division of Forests and Parks. Informal access to this artificial lake can be gained across the state land. The dam is owned by the state (DEM).

6. Florida

   North Pond - (DE-12) 18 Acres

   This natural great pond identified by the Division of Waterways (DEQE) is within the Florida State Forest administered by the Massachusetts Division of Forests and Parks. Informal public access to these public waters is across this state land. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife (DFW & RV). Fishing is allowed from nonpower boats. A beach and boat ramp have been developed.

7. Greenfield

No lakes, ponds, or reservoirs that meet the study criteria.

8. Hawley

Hallockville Pond #2-6-129-1 (DE-13) 18 Acres

This enlarged natural pond is within the Hawley State Forest under the administration of the Massachusetts Division of Forests and Parks (DEM), the owner of the dam. Informal access is available to the public across this state land.

Beaver Dam #2-6-129-3 (DE-13) 6 Acres

This small artificial pond is in the Hawley State Forest under the jurisdiction of DEM's Division of Forests and Parks. Informal public access is available across this state land. The dam is owned by DEM.

9. Heath

No lakes, ponds, or reservoirs that meet the study criteria.

10. Leyden

No lakes, ponds, or reservoirs that meet the study criteria.

11. Monroe

Browns Pond - (DE-11) 2 Acres

This small artificial pond is within the DEM's Monroe State Forest. Flowage is with DEM and informal public access for fishing is available over this state land.

12. Rowe

Pelham Lake #2-6-253-1 (DE-11) 73 Acres

This is an artificial municipally-owned lake. The dam is owned by the Town of Rowe. A town beach for town residents has been developed. There is no public access.

13. Savoy

Bog Pond #1-2-263-1 (DE-12) 39 Acres

The dam and flowage rights are owned by the state (DEM). This artificial pond is within the Savoy State Forest, and informal access to these public waters is available across the state land administered by the Massachusetts Division of Forests and Parks.

Burnett Pond #1-2-263-2 (DE-12) 17 Acres

This is an artificial pond located within the Savoy State Forest administered by DEM's Division of Forests and Parks. Informal public access can be gained across this state land. The dam is owned by the state.

South Pond - (DE-12) 25 Acres

This apparent natural great pond is within the Savoy State Forest managed by the Massachusetts Division of Forests and Parks, the owner of the dam and flowage rights. A small beach and small boat launch have been developed. Informal public access is available across this state land.

14. Shelburne

No lakes, ponds, or reservoirs that meet the study criteria.

FARMINGTON STUDY AREA COMMUNITIES

1. Granville

Borden Brook Reservoir #1-7-33-1 (WE-42) 205 Acres

This artificial impoundment serves as part of the water supply for the City of Springfield. Flowage is with the City of Springfield, and the reservoir is currently closed to public recreational use.

Cobble Mountain Reservoir #1-7-256-11 (WE-42) 1,043 Acres

This artificial impoundment serves as a water supply for the City of Springfield and the Town of Southwick. The dam and flowage is owned by the City of Springfield. No public recreational use is presently allowed.

Granville Reservoir #2-7-112-9 (WE-43) 70 Acres

No public use is allowed on this artificial impoundment used as a water supply by the City of Westfield. The dam and flowage is owned by the Westfield Water Commission.

Parsons Pond (FA-58) 13 Acres

This is an apparent natural great pond for which no public access has been obtained.

2. Otis

Big Pond #1-2-225-9 (FA-54) 331 Acres

Formal public access has been obtained by Berkshire County to the waters of this enlarged natural great pond identified by the Massachusetts Division of Waterways, (DEQE). A small boat launch has been developed by the Massachusetts Public Access Board. The dam is owned by the State Department of Environmental Management (DEM). The pond is stocked by the Massachusetts Division of Fisheries and Wildlife.

Benton Pond (FA-54) 59 Acres

This natural great pond has been identified by the Massachusetts Division of Waterways, (DEQE). Formal public access has been obtained by the County of Berkshire to these public waters. A boat launch has been constructed. and the pond is stocked by the Massachusetts Division of Fisheries and Wildlife.

Haley Pond (FA-54) 17 Acres

No formal public access has been obtained to the waters of this apparent natural great pond.

2. Otis (continued)

Hayden Pond #1-2-225-3 (FA-53) 38 Acres

This is an artificial municipally-owned pond. It is not presently open to public recreational use. The dam and flowage rights are owned by the Town of Otis.

Hayes Pond #1-2-225-7 (FA-53) 45 Acres

No formal public access has been obtained to the public waters of this apparent enlarged natural great pond. Flowage rights are with Mr. Egmont Cronan of Otis.

Horseshoe Pond (FA-53) 13 Acres

There is no formal public access to this apparent natural great pond.

Larkum Pond (FA-54) 19 Acres

This is an apparent enlarged natural great pond for which no formal public access has been obtained. The dam is owned by the Camp Fire Girls, Greater Boston Council.

Otis Reservoir #1-2-225-8 (FA-54) 1,065 Acres

Formal public access for boating is available across DEM's Tolland State Forest to the public waters of this apparent enlarged great pond. The Massachusetts Public Access Board has constructed a boat ramp. Flowage rights are with the State (DEM), and a beach has been developed. The lake is stocked with fish by the Massachusetts Division of Fisheries and Wildlife (DFW & RV).

Shaw Pond (FA-53) 80 Acres

This is an apparent great pond. Formal public access for boating has been acquired and developed by the Massachusetts Public Access Board.

White Lily Pond #1-2-225-6 (FA-54) 28 Acres

This is an apparent enlarged natural great pond. Informal access is available to the public across state land in the Otis State Forest managed by the Department of Environmental Management's Division of Forests and Parks. The dam is owned by Mr. John Boudarenko of Otis.

3. <u>Sandisfield</u>

Abbey Lake #1-2-260-10 (FA-55) 37 Acres

Flowage rights are with the Massachusetts Water Resources Commission, the owner of the dam and the surrounding land on this artificial impoundment. It was constructed under the Watershed Protection and Flood Prevention Act (PL-566). This project, a cooperative effort of federal, state, and town interests, provides flood control, fish and wildlife enhancement, and passive recreational benefits. Informal public access is available across this Commission land.

Clam Lake #1-2-260-11 (FA-55) 47 Acres

This artificial impoundment was constructed under the Watershed Protection and Flood Prevention Act (PL-566). The project, a cooperative effort of federal, state, and town interests, provides flood control and fish and wildlife enhancement benefits. Flowage rights are with the Massachusetts Water Resources Commission, the owner of the dam and surrounding land. Informal public access is available to the public across this Commission land.

Colebrook River Reservoir (FA-56) 760 Acres

This is an artificial flood control impoundment constructed by the U.S. Army Corps of Engineers (COE), the owner of the dam. Informal access is available to the public at the end of old Route #8. The lake is mostly in Connecticut.

North Silver Lake #1-2-260-13 (FA-55) 17 Acres

This artificial impoundment was constructed under the Watershed Protection and Flood Prevention Act (PL-566). The project, a cooperative effort of federal, state, and town interests, provides flood control, fish and wildlife enhancement, and passive recreational benefits. Flowage rights are with the Massachusetts Water Resources Commission, the owner of the dam and surrounding land. Informal public access is available across this Commission land.

Simons Pond (FA-56) 40 Acres

Formal public access has been obtained by the County of Berkshire to the waters of this <u>apparent natural great pond</u>.

3. Sandisfield (continued)

South Silver Lake #1-2-260-14 (FA-55) 15 Acres

This artificial impoundment was constructed under the Watershed Protection and Flood Prevention Act (PL-566). The project, a cooperative effort of federal, state, and local interests, provides flood control, fish and wildlife enhancement, and passive recreational benefits. Flowage rights are with the Massachusetts Water Resources Commission, the owner of the dam and surrounding land. Informal public access is available across this Commission land.

Spectacle Pond (Lower) #1-2-260-5 (FA-55) 62 Acres

No formal public access has been provided to the waters of this apparent enlarged natural great pond. The dam and flowage rights are with Rowley Bros. of Sandisfield.

Spectacle Pond (Upper) #1-2-260-8 (FA-55) 55 Ac es

This enlarged natural pond is in the DEM's Otis State Forest. Informal public access can be obtained across this state land. The dam is owned by DEM's Division of Forests and Parks. A small boat ramp has been constructed.

West Lake #1-2-260-9 (FA-55) 60 Acres

This artificial impoundment was constructed under the Watershed Protection and Flood Prevention Act (PL-566). The project, a cooperative effort of federal, state, and local interests provides flood control, fish and wildlife enhancement, and recreational benefits. Flowage rights are owned by the Massachusetts Water Resources Commission, the owner of the dam and surrounding land. A boat ramp and two beaches have been developed.

4. Tolland

Colebrook River Reservoir (FA-56) 760 Acres

(See Colebrook River Reservoir, Sandisfield)

Noyes Pond #1-7-297-5, 6 (FA-56) 166 Acres

This is an apparent enlarged natural great pond for which no formal public access has been obtained. The dam, flowage, and surrounding land is owned by the Tunxis Club.

MILLERS STUDY AREA COMMUNITIES

1. Ashburnham

Cheshire Pond (MI-2) 10 Acres

This is an apparent natural great pond with no formal public access.

Lincoln Pond (Mud Pond) #3-14-11-33 (NA-2) 29 Acres

This is an apparent enlarged natural great pond with no formal public access. The dam may be breached at present.

Lower Naukeag Lake #3-14-11-7 (MI-2) 260 Acres

This is an apparent enlarged great pond with no formal public access. The Town of Ashburnham owns the dam and flowage rights.

Upper Naukeag Lake #3-14-11-8 (MI-2) 316 Acres

This apparent enlarged great pond has been withdrawn for water supply by the Towns of Ashburnham and Winchendon. The dam and flowage rights are owned by the Town of Winchendon. Shore fishing by permit is allowed for residents of both towns only.

Ward Pond (Billy Ward Pond) #3-14-11-34 (NA-1) 51 Acres

This is an enlarged great pond designated by the Division of Waterways, DEQE. The dam and flowage rights are owned by Souhegan Realty. No formal public access has been established.

Watatic Pond (NA-1) 21 Acres

This is an apparent natural great pond with no formal public access.

Winnekeag Lake (Rices Reservoir) #3-14-11-22 (NA-2) 115 Acres

This is an apparent enlarged great pond with no formal public access. The dam and flowage rights are owned by the James River Massachusetts Company. It is stocked by the Massachusetts Division of Fisheries and Wildlife.

2. Athol

Newton Reservoir #3-14-15-26 (MI-2) 20 Acres

This is a municipally-owned artificial reservoir used for water supply. The Town of Athol owns the dam and flowage rights. Public access for recreation has been closed.

Phillipston Reservoir #3-14-235-1 (MI-2) 22 Acres

(See Phillipston Reservoir, Phillipston)

Reservoir #2 #3-14-15-50A, 50 (MI-4) 50 Acres

(See Reservoir #2, Phillipston)

Riceville Pond #3-14-15-51 (MI-4) 71 Acres

(See Riceville Pond, Petersham)

Silver Lake (MI-2) 11 Acres

This is an apparent natural great pond with no formal public access.

White Pond #3-14-15-35 (MI-4) 67 Acres

This is an apparent enlarged great pond with no formal public access. The dam and flowage rights are owned by White Pond Associates.

3. Erving

Laurel Lake #2-6-312-8 (MI-5) 48 Acres

This is an apparent enlarged great pond located in Erving State Forest, administered by DEM, Division of Forests and Parks. Informal access is available across the state park land. It is stocked by the Massachusetts Division of Fisheries and Wildlife. A boat ramp has been developed on this state land.

4. Gardner

Cowee Pond (Marm John's Pond) #3-14-103-14 (MI-1) 20 Acres

This is a municipally-owned artificial pond used for water supply by the City of Gardner, the owner of the dam and flowage rights. There is no present public recreational use allowed.

4. Gardner (continued)

Crystal Lake #3-14-103-21 (MI-1) 147 Acres

This is an apparent enlarged great pond withdrawn for water supply. The dam and flowage rights are owned by the City of Gardner. No public recreational use is presently allowed.

Kendall Pond (Hines Pond) (MI-1) 23 Acres

This is a natural great pond surveyed by the Division of Waterways, DEQE. It is stocked by the Division of Fisheries and Wildlife. No formal access has been established.

Parker Pond #3-14-103-12 (MI-1) 29 Acres

This is a municipally-owned artificial pond with no formal public access. The City of Gardner owns the dam and flowage rights.

Perley Brook Reservoir #3-14-103-13 (MI-1) 55 Acres

This is a municipally-owned artificial reservoir used for water supply by the City of Gardner. The dam and flowage rights are owned by Gardner. The reservoir is closed to recreational use.

Wrights Reservoir #3-14-103-11 (MI-1) 128 Acres
(South Gardner Reservoir)

This is a municipally-owned artificial reservoir used for flood control. The City of Gardner owns the dam and flowage rights. No public access has been obtained.

5. Orange

Lake Mattawa #2-6-223-4A, B (CP-27) 112 Acres

This is an apparent enlarged great pond. At present, informal public access can be gained over a town-owned boat ramp. The dam and flowage rights are owned by the Town of Orange. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife (DFW & RV).

Packard Pond #2-6-223-12 (MI-3) 42 Acres

This is an apparent enlarged great pond with no formal public access. The Packard Heights Association owns the dam and flowage rights.

5. <u>Orange (continued)</u>

Tully Pond #2-6-223-11 (MI-3) 78 Acres

This is a municipally-owned artificial pond with no public access. The Town of Orange owns the dam and flowage rights.

6. <u>Royalston</u>

Beaver Pond (MI-2) 50 Acres

This is a publicly-owned artificial pond located in the Birch Hill Wildlife Management Area. Informal access is available from a boat ramp constructed by the Massachusetts Division of Fisheries and Wildlife across this management area land.

Little Pond (Horseshoe Pond) (MI-3) 10 Acres

This is an <u>apparent natural great pond</u> with no formal public access. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife (DPW & RV).

Long Pond (MI-3) 40 Acres

This is an <u>apparent natural great pond</u> located within the Tully Lake area owned by the U.S. Army Corps of Engineers. Informal access for shore fishing is available across DEM leased land.

Tully Lake #3-14-255-16 (MI-3) 300 Acres

This is an artificial flood control reservoir constructed by the U.S. Army Corps of Engineers (COE), the owner of the dam. Most of the land area is leased to the Massachusetts Department of Environmental Management (DEM) for recreational purposes. Informal access is available to the public across this public land. A small boat landing has been developed.

7. <u>Templeton</u>

Greenwood Pond #3-14-294-20 (MI-1) 25 Acres

This is a publicly-owned artificial pond. Informal public access can be gained across state Routes 101/2A. The Massachusetts Department of Public Works owns the dam and flowage rights.

7. Templeton (continued)

Stone Bridge Pond #3-14-294-23 (CP-29) 34 Acres

This is a publicly-owned artificial pond located within the MDC's Ware River Watershed. No formal access has been developed. The dam and flowage rights are owned by the MDC, Water Division.

8. Warwick

Hastings Pond #2-6-312-6 (MI-5) 20 Acres

This is an apparent enlarged great pond. The dam and flowage rights are owned by Ralph Torstensen of Warwick. No formal public access has been established.

Laurel Lake #2-6-312-8 (MI-5) 48 Acres

(See Laurel Lake, Erving)

Moores Pond #2-6-312-2 (MI-5) 31 Acres

An apparent enlarged great pond. The dam and flowage rights are owned by G. Shepherdson. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife. No formal public access has been established.

Richards Mill Pond #2-6-312-4 (MI-5) 5 Acres

This is a publicly-owned artificial pond, located in the Warwick State Forest, administered by DEM's Division of Forests and Parks. Informal access for shore fishing is available across this state park land.

Richards Reservoir #2-6-312-5A (MI-5) 30 Acres

This publicly-owned artificial pond, located in the Warwick State Forest, is administered by DEM, Division of Forests and Parks. Informal access for shore fishing is available across this state park land.

Sheomet Lake (Club Pond) #2-6-312-7 (MI-3) 31 Acres

This publicly-owned artificial pond is located in Warwick State Forest, administered by DEM, Division of Forests and Parks. Informal access to a blacktopped boat ramp and for shore fishing is available across state park land.

9. Wendell

Ruggles Pond #2-6-319-3 (MI-6) 10 Acres

This is a publicly-owned artificial pond, located in the Wendell State Forest, adminstered by DEM, Division of Forests and Parks. Informal access to a swimming beach and for shore fishing is available across state park land.

Wickett Pond (MI-6) 32 Acres

This is an apparent natural great pond, located in the Wendell State Forest, administered by DEM, Division of Forests and Parks. Informal access to a boat ramp is available across this state forest land.

10. Winchendon

Beaman Pond #3-14-343-21 (MI-1) 3 Acres

This is a publicly-owned artificial pond located in Otter River State Park, administered by DEM, Division of Forests and Parks. Informal access to a swimming beach is available across state park land.

Lake Denison (MI-2) 82 Acres

This is an apparent natural great pond located within the U.S. Army Corps of Engineers' Birch Hill Reservoir area. The area is leased to the Massachusetts Department of Environmental Management (DEM). Informal public access is available across this leased land known as the Lake Denison Camping Area. A beach and boat ramp have been developed by DEM's Division of Forests and Parks.

Lake Monomonock #3-14-343, 3, 3A (MI-2) 592 Acres

This is an apparent enlarged great pond with no formal public access. The Town of Winchendon owns the dam and flowage rights.

Mud Pond (Carter Pond) (MI-1) 2 Acres

This is a small artificial pond located in the Birch Hill Wildlife Management Area, administered by the Massachusetts Division of Fisheries and Wildlife. Informal access is available across this wildlife management area land for shore fishing.

10. <u>Winchendon (continued)</u>

Whitney Pond	#3-14-343-5	(MI-2)	105 Acres

This is a municipally-owned artificial pond used for recreation. The dam and flowage rights are owned by the Town of Winchendon. No public access has been established.

NORTHERN CONNECTICUT VALLEY STUDY AREA COMMUNITIES

1. Bernardston

   No lakes, ponds, or reservoirs that meet the study criteria.

2. Gill

   No lakes, ponds, or reservoirs that meet the study criteria.

3. Northfield

   No lakes, ponds, or reservoirs that meet the study criteria.

SOUTHERN CONNECTICUT VALLEY STUDY
AREA COMMUNITIES

1. Agawam

Robinson Pond #2-7-5-9 (WE-46) 3.5 Acres

This is a publicly-owned artificial pond located in Robinson State Park, administered by DEM, Division of Forests and Parks. Informal access from a swimming beach is available across state park land.

2. East Longmeadow

No lakes, ponds, or reservoirs that meet the study criteria.

3. Hampden

No lakes, ponds, or reservoirs that meet the study criteria.

4. Longmeadow

No lakes, ponds, or reservoirs that meet the study criteria.

5. Springfield

Bass Pond (Bash Pond) - (SC-47) 12 Acres

This is an apparent natural great pond with no formal public access.

Dimmock Pond - (CP-35) 10 Acres

No formal public access has been established for this apparent natural great pond.

Five Mile Pond - (SC-47) 40 Acres

This is a natural great pond surveyed by the Division of Waterways (DEQE). Formal public access has been established by Hampden County. The pond has been stocked by the Division of Fisheries and Wildlife.

Indian Orchard Pond (Long Pond) - (CP-35) 18 Acres

A natural great pond surveyed by the Division of Waterways (DEQE) with no formal public access.

Loon Pond - (SC-47) 29 Acres

Another natural great pond surveyed by the Division of Waterways (DEQE). Formal public access has been developed by Hampden County.

5. Springfield (continued)

Lake Lorraine - (CP-35) 30 Acres

This is a natural great pond surveyed by the Division of Waterways (DEQE). Formal public access has been established by Hampden County. It is stocked by the Division of Fisheries and Wildlife.

Mona Lake - (CP-35) 11 Acres

A natural great pond surveyed by the Division of Waterways (DEQE) with no formal public access.

Porter Lake #2-7-281-2, 3 (SC-48) 28 Acres

This is a municipally-owned artificial pond with no formal public access. The dam and flowage rights are owned by the City of Springfield, Park Department.

Watershops Pond #2-7-281-4 (SC-47) 169 Acres

A municipally-owned artificial pond with access for nonpower boating across city land. The City of Springfield, Park Department owns the dam and flowage rights. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife (DFW & RV).

6. Wilbraham

Nine Mile Pond - (CP-35) 30 Acres

This is a natural great pond designated by the Division of Waterways (DEQE). Formal public access has been established by Hampden County.

Spectacle Pond - (CP-35) 16 Acres

No formal public access has been developed for this apparent natural great pond.

WESTFIELD STUDY AREA COMMUNITIES

1. Becket

Buckley-Dunton Reservoir #1-2-22-3 (WE-38) 195 Acres

This is an artificial impoundment within the October Mountain State Forest. The dam and flowage rights are owned by the Massachusetts Department of Environmental Management (DEM). Informal access is available across this State Forest land.

Center Pond #1-2-22-13 (WE-38) 110 Acres

This is an enlarged great pond, surveyed by the Division of Waterways, (DEQE) with flowage rights owned by R. W. Mettler, Jr. Formal access has been acquired by Berkshire County, but this right-of-way has not been developed.

Greenwater Pond #1-2-22-6 (HO-6) 88 Acres

This is an enlarged great pond, surveyed by the Division of Waterways, (DEQE). The dam and flowage rights are owned by the Commonwealth of Massachusetts, Division of Waterways. Informal public access is available across state highway land on Route #20. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife, (DFW & RV).

Horn Pond (WE-38) 25 Acres

This is an apparent natural great pond used for water supply by the Town of Chester. No public access is permitted.

Rudd Pond #1-2-22-9 (WE-38) 80 Acres

This is an apparent enlarged great pond. The dam and flowage rights are owned by the YMCA of Massachusetts and Rhode Island. No formal public access has been established.

Shaw Pond (FA-53) 80 Acres

(See Shaw Pond, Otis - Farmington Study Area)

Yokum Pond #1-2-22-12 (WE-38) 109 Acres

This is an enlarged great pond surveyed by the Division of Waterways, (DEQE). The dam and flowage rights are owned by Frederick J. Mercer of Great Barrington. At present, informal access is available off Leonhardt Road on land owned by the Town of Becket.

2. Blandford

Blair Pond (Pixley Pond) (WE-42) 70 Acres

This is an apparent natural great pond used for water supply by the City of Springfield. No public access is permitted.

Borden Brook Reservoir #1-7-33-1 (WE-42) 205 Acres

(See Borden Brook Reservoir, Granville - Farmington Study Area)

Cobble Mountain Reservoir #1-7-256-11 (WE-42) 1,135 Acres

This is a municipally-owned, artificial water supply reservoir. The dam and flowage rights are owned by the City of Springfield. No public access is permitted.

Long Pond (Lincoln Pond) #1-7-33-7 (WE-42) 84 Acres

This is an enlarged great pond surveyed by the Division of Waterways, (DEQE). The Town of Blandford uses the pond as water supply. The town owns the dam and flowage rights. There is no public access since the right to use a former Hampden County right-of-way has been discontinued.

3. Chester

Littleville Reservoir #1-8-143-7 (WE-37) 275 Acres

This is an artificial flood control reservoir owned by the U.S. Army Corps of Engineers. Informal public access is available across this U.S. Army Corps of Engineers' land. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife. The City of Springfield has an agreement with the Corps to use this reservoir as an emergency water supply. Two boat ramps have been constructed for public use.

4. Chesterfield

No lakes, ponds, or reservoirs that meet the study criteria.

5. Cummington

No lakes, ponds, or reservoirs that meet the study criteria.

6. Goshen

Lower Highland Lake (Lower Goshen Reservoir)
#2-8-108-3 (CV-22) 91 Acres

This is an artificial publicly-owned reservoir. Flowage rights are with the Massachusetts Department of Environmental Management. Formal public access has been established by the Public Access Board on DAR State Forest land under the management of the Massachusetts Division of Forests and Parks (DEM). Presently, non-power boats are permitted.

Upper Highland Lake (Connecticut Lake)
#2-8-108-2, 4 (CV-22) 69 Acres

This is an artificial publicly-owned reservoir. Flowage rights are with the Department of Environmental Management (DEM). Informal public access is available across state land in the DAR State Forest. A boat ramp has been constructed.

7. Huntington

Norwich Pond #1-8-143-6 (WE-36) 122 Acres

This is an enlarged great pond identified by the Division of Waterways, (DEQE). Formal public access has been developed by Hampshire County. The Town of Huntington owns the dam and flowage rights.

8. Middlefield

No lakes, ponds, or reservoirs that meet the study criteria.

9. Montgomery

Westfield Reservoir (Montgomery Reservoir)
#1-7-194-1 (WE-39) 35 Acres

This is a municipally-owned artificial reservoir used for emergency water supply. The City of Westfield owns the dams and flowage rights. No public access is permitted.

10. Peru

Ashmere Lake #1-2-132-1 (HO-3) 217 Acres

(See Ashmere Lake, Hinsdale - Housatonic Study Area)

11. Plainfield

Crooked Pond #2-8-237-3 (WE-36) 34 Acres

This is an apparent enlarged great pond. The dam and flowage rights are owned by the Massachusetts Department of Environmental Management (DEM). Informal public access can be gained across state land in the Hawley State Forest administered by DEM's Division of Forests and Parks.

Plainfield Pond #2-8-237-4 (DE-13) 57 Acres

This is an apparent enlarged great pond. The dam and flowage rights are owned by the Massachusetts Department of Environmental Management. Informal public access can be gained across state land in the Hawley State Forest off Route #116.

Hallockville Pond #2-6-129-1 (DE-13) 18 Acres

(See Hallockville Pond, Hawley - Deerfield Study Area)

12. Russell

Cobble Mountain Reservoir #1-7-256-11 (WE-42) 1,135 Acres

(See Cobble Mountain Reservoir, Blandford)

Russell Pond (Hazzard Pond) #1-7-256-2 (WE-41) 80 Acres

This is an enlarged great pond identifield by the Division of Waterways, (DEQE). The dam and flowage rights are owned by the Strathmore Paper Company, West Springfield. A Boy Scout Camp and town beach are located on the pond, but no formal public access has been obtained. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife (DFW & RV).

13. Southwick

Congamond Lakes #2-7-279-4, 5, 6 (WE-45) 450 Acres

These are enlarged great ponds surveyed by the Division of Waterways, (DEQE). The dams and flowage rights are owned by the Town of Southwick. Formal public access has been established by the Massachusetts Public Access Board for boating. A boat ramp has been developed. The pond is stocked by the Division of Fisheries and Wildlife (DFW & RV).

14. Westfield

Buck Pond (WE-44) 25 Acres

This is a natural great pond surveyed by the Division of Waterways, (DEQE). No public access has been established.

Horse Pond #2-7-329-1 (WE-44) 30 Acres

This is an enlarged great pond surveyed by the Division of Waterways, (DEQE). The City of Westfield owns the dam and flowage rights. No formal public access has been obtained.

Pequot Pond (WE-44) 154 Acres

This is an enlarged great pond surveyed by the Division of Waterways, (DEQE). The dam (control structure) is on adjacent Horse Pond in Westfield, and it is owned by the City of Westfield. Two public beaches and a boat ramp have been developed on the adjoining Hampton Ponds State Park administered by the Massachusetts Division of Forests and Parks, (DEM). Informal public access is available across state land. The pond is stocked for fishing by the Massachusetts Division of Fisheries and Wildlife (DFW & RV).

15. West Springfield

No lakes, ponds, or reservoirs that meet study criteria.

16. Windsor

Windsor Pond (SE-36) 48 Acres

This is an apparent natural great pond. Formal public access is provided by the Massachusetts Public Access Board. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife (DFW & RV).

Windsor Reservoir #1-2-345 (HO-3) 81 Acres

(See Windsor Reservoir, Hinsdale - Housatonic Study Area)

17. Worthington

No lakes, ponds, or reservoirs that meet the study criteria.

APPENDIX D

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